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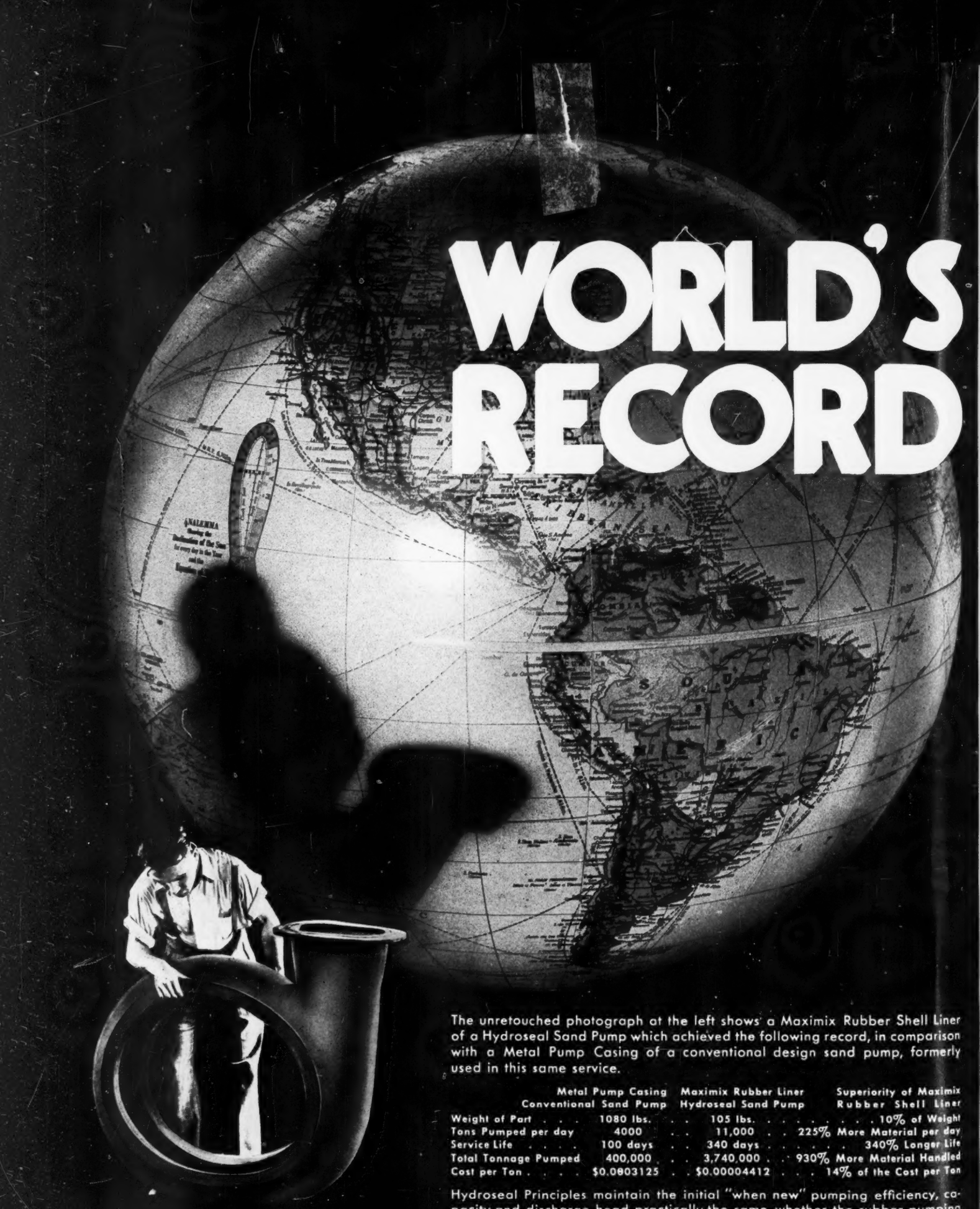

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BY PROCLAMATION on December 31, 1937, the President reduced from 77.57c to 64.64c the price to be paid by coinage mints for silver mined from natural deposits in the United States during the calendar year 1938. Details will be found on page 78 of this issue.

Appropriations for The Bureau of Mines

THIS IS THE SEASON when Congress makes appropriations for governmental agencies for the next fiscal year. Among others, the Bureau of Mines will present its case before appropriations committees, hopeful of reasonable support for the work of its major branches—technologic, economics and statistics, and health and safety. All are important to the mining industry and should command the personal backing of its members. We emphasize "personal backing" because, although Congress as a whole may care little what an industry thinks or wants, individual members of the House and Senate give ear to the personal views of their constituents. So, if you are interested in the welfare of the Bureau of Mines, communicate your views to your Representatives and Senators.

Meantime, without disparaging the work of the other branches, we raise our voice in behalf of the economics and statistics branch of the Bureau. In our judgment it does not receive financial support commensurate with its present worth, to say nothing of its potential service to the mining industry if adequately supplied with funds. This embarrassment, we believe, arises not from friction within the Bureau itself or in the failure of the Director to appreciate the value of economic and statistical studies. Quite the contrary.

The difficulty lies in the inability or unwillingness of Congressmen to comprehend the relative importance of such work. On the other hand, they seem to grasp quickly the significance of technologic studies. Not from any deep devotion to the progress of science and engineering, but because such investigations hold promise of spending money in favored States, to the personal political glory of members of Congress.

Economic and statistical studies of the Bureau of Mines should be expanded and more generously supported. They are vital to the orderly conduct of the mining business. Timely information is needed on production, consumption, and stocks of metals, both primary and secondary. Producers as well as consumers need such data for the sake of stability. Here is work that can best be done by an impartial governmental agency acting in the public interest. Hence we urge adequate support not only for the Bureau as a whole, but specifically for a branch of its work that is too likely to be neglected by those who hold the purse strings.

Silver by the Pound

RECENTLY we have been conducting our own private intelligence test. To all and sundry who would listen—engineers, industrialists, manufacturers—we posed the following question: How much does silver cost by the pound avoirdupois in the open market? We specified the open market because all newly mined domestic silver is in a class by itself, being bought by the Treasury at a special price. And now we ask you to answer without resorting to pencil and paper or mental calculation, How much is silver worth by the pound avoidupois? After you have made your guess, figure it out on the basis of 44.75¢ per fine troy ounce. Then try it on your friends. Their answers will probably show a wide range. To many it will come as a surprise to learn that, in round figures, the answer is only $6.50.

Of course we had an ulterior motive in asking the question. We wanted to dispel the common illusion that silver is a costly metal, too costly to be used by the pound for industrial purposes. For, curiously enough, one of the greatest obstacles encountered by those who are trying to promote industrial uses of silver is the common conception that "it will cost too much." This

answer is given repeatedly by manufacturers who would not balk at the intelligent use of other less common metals in the same price class with silver. The reason is not hard to find. Silver has always been classed as one of the noble or precious metals. It is commonly linked with gold; not only in conversation, but in monetary systems and for personal adornment. And yet the current price of gold is nearly 80 times that of silver. They are not in the same price class.

In order to get a clearer idea of the relation of silver to other industrial metals with respect to price by the pound, we arranged 30 metals in order of ascending market quotations for comparably pure products. They ranged, in round figures, from antimony at 15¢ to rhodium at $2,000. They fell into four price groups: 15¢ to $2; $6 to $9.50; $15 to $72; and $510 to $2,000. Silver is in the second price group with molybdenum, thallium, titanium, tungsten, and zirconium, and far below the gold-platinum group with which popular opinion is inclined to associate it. If we are going to encourage industrial uses of silver, it will be necessary to spread among potential consumers the truth about its cost. Commercially speaking, it is not an expensive metal.

Emanuel Swedenborg —Mine Assessor

HOW MANY MINING MEN are aware that Sweden's eminent theologian and religious teacher, Emanuel Swedenborg, born in 1688, was prominent in his country's mining industry for over thirty years as assessor of the Swedish Board of Mines? During this period, from 1716 to 1747, he labored to have his Government accord the iron industry a position of more importance, believing that too great emphasis had hitherto been placed on the mining of silver and copper. He came to this conclusion after studying the mines and metallurgical plants of Sweden, Saxony, Bohemia, and Austria, and of the rolling mills at Liége. For years he sought to introduce improved methods of working iron, and to have the product finished at home instead of merely exporting the ore as raw material. As a result, "Swede's iron" became celebrated throughout the world. In 1734 he published "De Ferro" and "De Cupro," two notable volumes dealing with the mining and metallurgy of iron and steel and of copper respectively.

But all this is but a glimpse of Swedenborg. First and foremost, in his technical pursuits, he was a physicist and mathematician, illustrating the importance of fundamentals. He also made his mark in physiological research. He was the predecessor of Scandinavian geologists. And let us not fail to mention that he was editor of the first technical magazine produced in Sweden. All this apart from his studies in metaphysics and theology. This month, on Jan. 29, the 250th anniversary of his birth will be celebrated throughout the world.

Centenary of Vieille-Montagne

SELDOM does a mining enterprise celebrate the hundredth anniversary of its organization and at the same time hold the dominant position in production as well as age. Oldest of the world's zinc producers, Vieille-Montagne, of Belgium, is also the largest, having produced 117,600 metric tons in 1936. Founded in 1837 as the Société des Mines et Fonderies de Zinc de la Vieille-Montagne, it comprised the Moresnet mine, a smelter at Liége, two rolling mills in France, another at Dartford, England, and a second smelter under construction at Angleur, near Liége. Since then it has progressively expanded its operations, but has always confined its attention to a single metal, zinc. Not the least interesting item in its century of history is the fact that for 90 years the organization has been under the active direction of only two men, father and son. Louis Alexandre Saint-Paul de Sinçay became managing director in 1846, and on his death in 1890 he was succeeded by his son, Gaston Saint-Paul, who now manages the Société. The centenary was fittingly celebrated late in 1937 by a ceremony attended by 1,200 persons at the Palais des Fêtes of the City of Liége.

Certified-Check Swindlers

EQUIPMENT MANUFACTURERS from widely separated cities have notified us of the activities of an individual posing as a mine owner placing orders for mining and milling machinery. He offers in payment a certified check on a Western bank. The amount of the check is larger than the price of the equipment, and the difference is collected from the manufacturer. Subsequently the certified check is found to be a forgery. We warn manufacturers against such racketeers and urge them to report incidents of this kind to police authorities and the Better Business Bureau.

IN THE LA RUE PIT, a view taken last March before shipping from the stockpile was started. Skirting the base of the stockpile is field conveyor No. 9, shown also on the maps in Figs. 2 and 3. The belts are removed during the winter from the pit and surface conveyors that are exposed and shut down. Only the conveyor that receives the current production from the underground system and delivers it to the stockpile-car-loading hopper is housed in a heated gallery for winter operation. This unit is to be seen at the left of the picture

Conveyor Transport

In an Underground Mine on the Mesabi

LaRue workings planned from start for belt haulage — Adjacent open pit similarly served

Grover J. Holt
Mining Engineer, Butler Brothers
St. Paul, Minn.

ALMOST SIX YEARS AGO, in 1932, Butler Brothers leased the LaRue property, on the outskirts of Nashwauk, on the Mesabi range. The ore available by open-pit mining methods had been exhausted, but a lens of wash ore 20 to 30 ft. thick had been traced from an exposure in the open pit dipping gently to the east. This lens was overlain by 75 to 150 ft. of taconite and more than 30 ft. of surface material, which eliminated the possibility of mining it by the use of open-pit methods.

Prior to 1932 Emmett Butler, president of Butler Brothers, had investigated the use of conveyor belts for transport in other lines of material-moving and had decided to adopt this means in connection with the underground mining of the lens when the property was leased. The ore dipped about 15 deg. from the horizontal, which was ideal for transportation by conveyor.

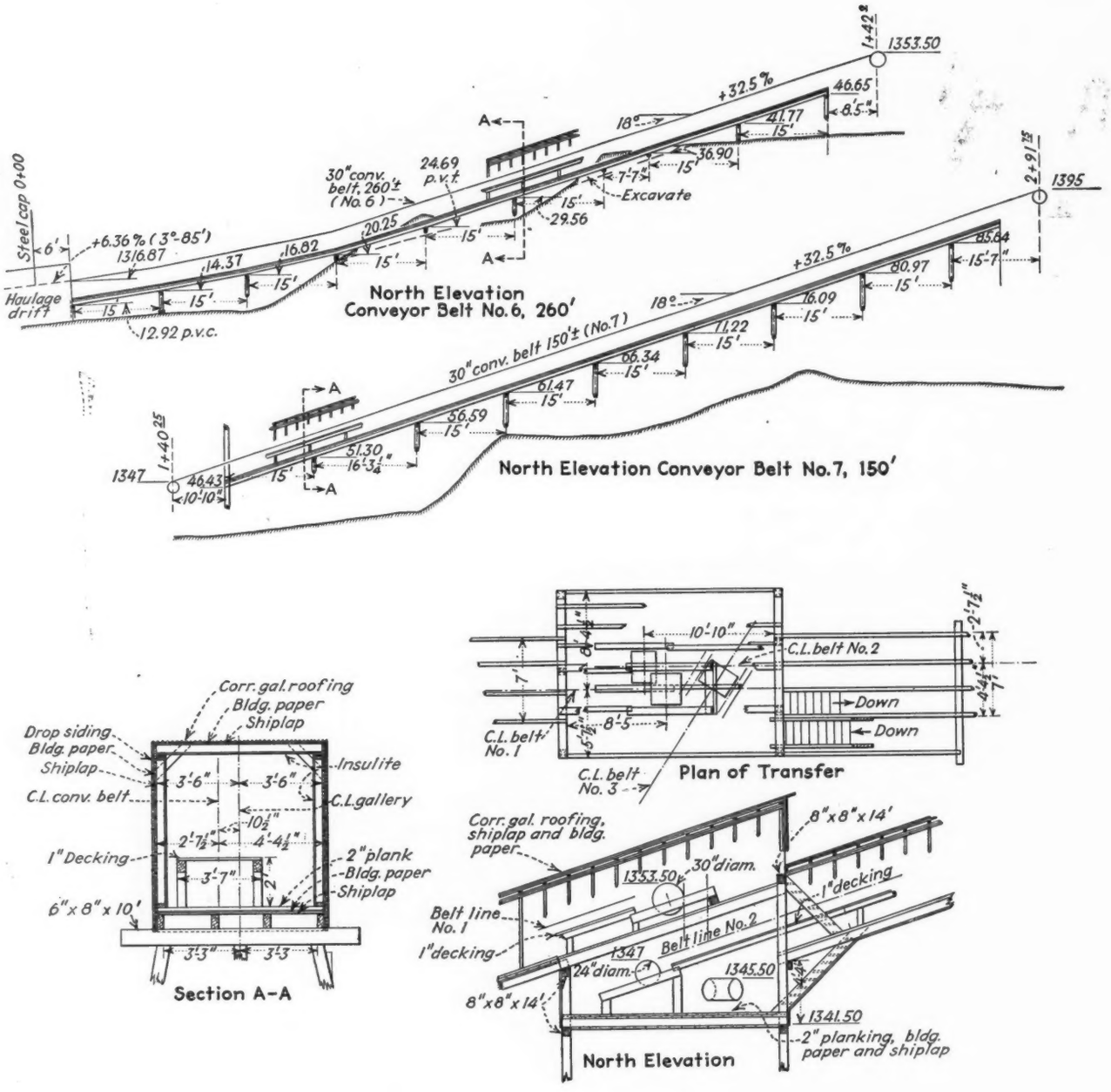
Because of the massive taconite back over the ore, it was thought that large rooms could be worked, and loading from the working place onto the conveyor belt with an electric shovel was tried. The rock back, however, was found to be too treacherous for the 16-ft. clear span required for the operation of the shovel, and consequently shovel work was abandoned in favor of tuggers and scrapers.

Drifts are maintained on two levels throughout the mine, the upper being a timber sublevel drift connecting with the working places on this level and the other the main level drift. It is on the latter that the various conveyor units now in service are installed.

Standard Mesabi top-slicing and sublevel caving methods are used in mining the ore. Raises are put up at regular intervals from the main drift, usually 50 ft. apart, and crosscuts run on the sublevel alternately to right and left at right angles to the sublevel timber drift until the mining limits are reached, usually a distance of 300 to 500 ft. Slicing is then begun on the sublevel, with gangs using 20-hp. electric tuggers having a rope speed of about 200 ft. per minute and delivering the ore by means of 1-cu.yd. scrapers from the working place into the crosscut. Here a large 40-hp. electric tugger operating a 1½-cu.yd. scraper at a rope speed of 500 ft. per minute delivers the ore to the raise for loading onto the conveyor belt by means of a chute having a simple adjustable gate.

When mining has been completed on the sublevel, crosscuts are run out from the main level alternately to right and left and the ore is loaded directly from them into small hoppers over the conveyor belt by means of the large scrapers.

UNDERGROUND in the LaRue mine. A typical portion of the transport conveyor system is shown; also a loading chute that delivers ore to the conveyor from a sublevel stope



The mining layout is shown in part on the map in Fig 2. It will be noted that the main level drifts have been laid out to allow for the development of the maximum tonnage from each crosscut to reduce development expense. Ample pillars have been left to protect both main and sublevel drifts, mining having been started as rapidly as working places could be opened up. Development work is kept only slightly ahead of the requirements of the mining program.

Inasmuch as the ore produced during the winter must be stockpiled because the washing plants are then shut down and Lake transportation has stopped, it has been found economical to do this by means of dump cars drawn by small electric locomotives. This avoids the difficulty of having the moist ore freeze to the exposed belts, if the latter were used for the purpose. All through the winter season ore is delivered by a continuous chain of underground conveyor belts from the working places to the portal of the main drift in the open pit and from this point through an inclosed and heated conveyor gallery to the hopper from which the stockpile cars are loaded. This requires a total of 2,135 ft. of underground conveyor and 410 ft. of conveyor in the inclosed gallery. The ore stocked is spread over an area of ground about 200 ft. wide and 500 ft. long, to an average height of about 35 ft.

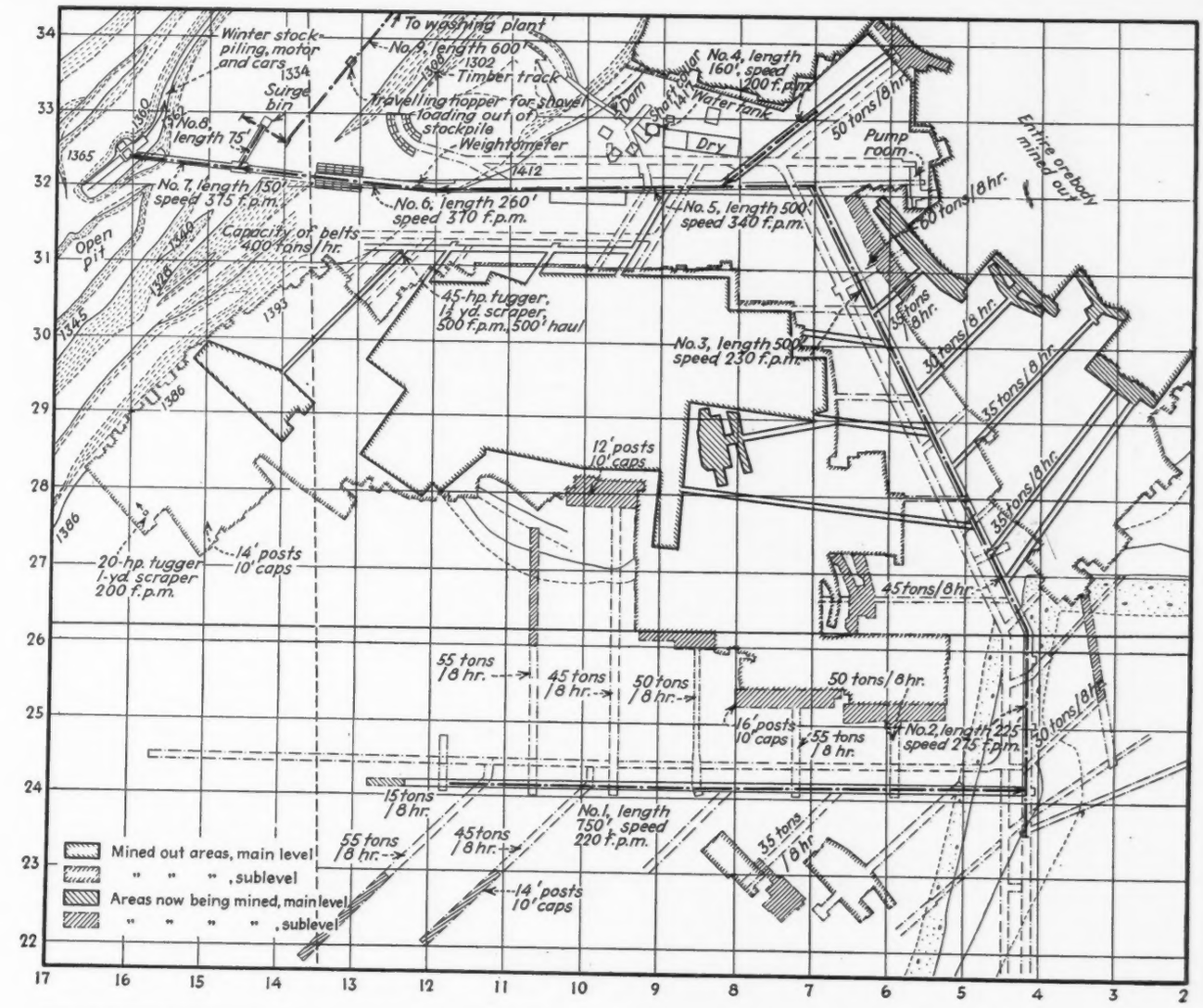
The loading hopper is located on a

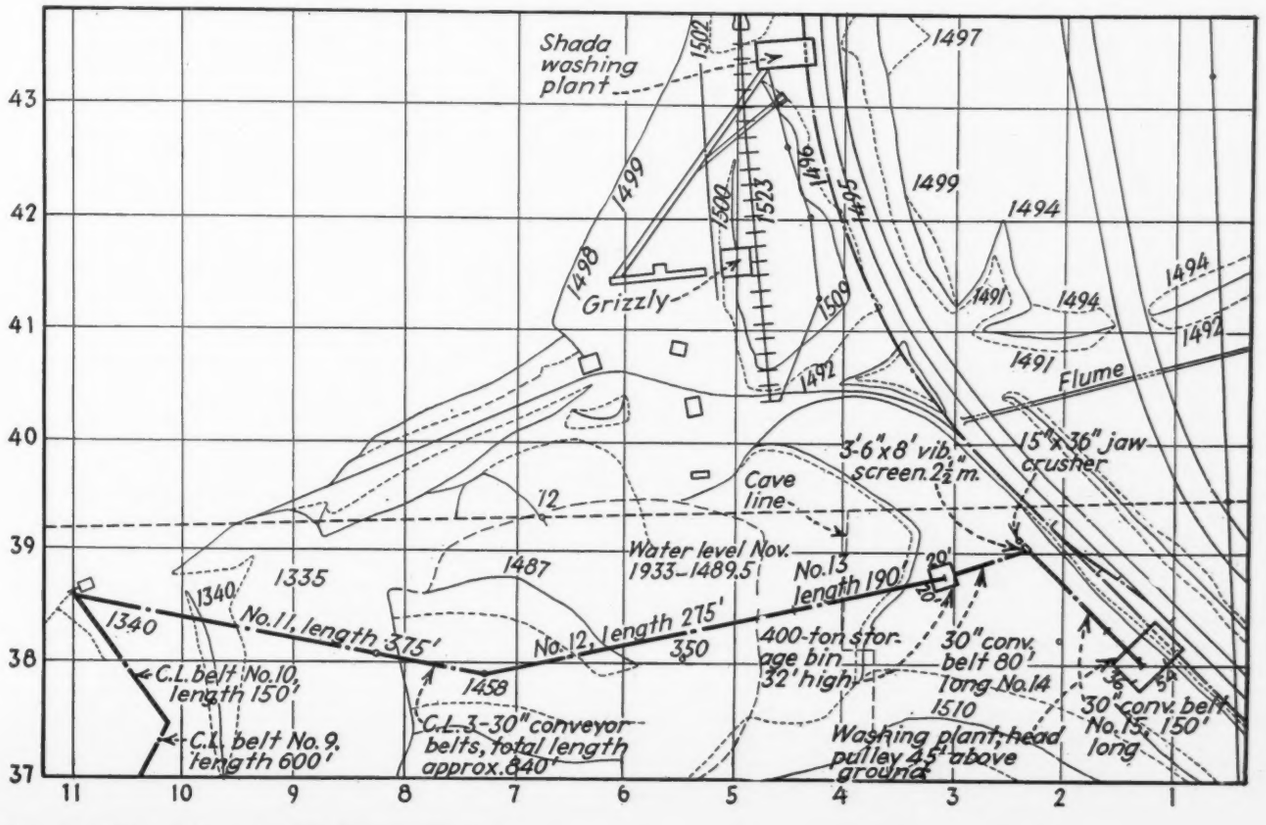
(*Continued on page 52*)

Fig. 1 (above) . . . SOME DETAILS of the construction of the LaRue conveyor system

Fig. 2 (top of p. 31) . . . THE CONVEYOR SYSTEM, laid out as shown by the heavy black dot-dash line, serves the LaRue workings, delivering the ore eventually to the washing plant on surface by way of the adjacent open pit. Conveyors Nos. 1 to 9 inclusive are illustrated. See also Fig. 3. Mining methods used are standard Mesabi top-slicing and sublevel caving

Fig. 3 (bottom of p. 31) . . . FIELD CONVEYOR, No. 9, in the LaRue open pit, during the shipping season delivers current ore production from the underground system as well as the ore loaded from the stockpile to a system of conveyors which elevate the ore out of the pit and take it to the washing plant. This map, on a different scale from Fig. 1, shows conveyors 9 to 12


To washing plant
No.9, length 600'
Winter stock-piling, motor and cars
Timber track
Surge bin
No.8, length 75'
No.4, length 160', speed 200 f.p.m.
Dam
Shaft collar
Water tank
Dry
Weightometer
Travelling hopper for shovel loading out of stockpile
50 tons/8 hr.
Pump room
Entire orebody mined out
No. 7, length 150' speed 315 f.p.m.
No. 6, length 260' speed 310 f.p.m.
No. 5, length 500' speed 340 f.p.m.
60 tons/8 hr.
Open pit
Capacity of belts 400 tons/hr.
45-hp. tugger, 1½ yd. scraper, 500 f.p.m., 500' haul
No.3, length 500' speed 230 f.p.m.
30 tons/8 hr.
35 tons/8 hr.
12' posts 10' caps
20-hp. tugger 1-yd. scraper 200 f.p.m.
14' posts 10' caps
45 tons/8 hr.
55 tons/8 hr.
45 tons/8 hr.
50 tons/8 hr.
50 tons/8 hr.
16' posts 10' caps
55 tons/8 hr.
No.2, length 225' speed 275 f.p.m.
30 tons/8 hr.
15 tons/8 hr.
No.1, length 150' speed 220 f.p.m.
55 tons/8 hr.
45 tons/8 hr.
35 tons/8 hr.
14' posts 10' caps
Mined out areas, main level
" " " , sublevel
Areas now being mined, main level
" " " " , sublevel


Shada washing plant
Grizzly
Flume
3'-6"x8' vib. screen, 2½" m.
15"x36" jaw crusher
Cave line
Water level Nov. 1933—1489.5
No.13 length 190'
No.11, length 375'
No.12, length 275'
400-ton storage bin 32' high
30" conv. belt 80' long No.14
30" conv. belt No.15, 150' long
C.L. belt No.10, length 150'
C.L. belt No.9, length 600'
C.L. 3-30" conveyor belts, total length approx. 840'
Washing plant, head pulley 45' above ground

AT THE SITE OF THE NEW PLANT near the portal of the main haulage, or 1,500, level, which is 3,500 ft. above the sea. The crushing plant section of the mill is seen, on the mountainside about 220 ft. above the level of the permanent camp on the canyon floor. In the foreground is the substation, under construction. This picture was taken Oct. 24, 1937

Howe Sound's Holden Mine Nears Production

Gold-copper property in Chelan range, in Washington, equipped with 1,000-ton flotation plant

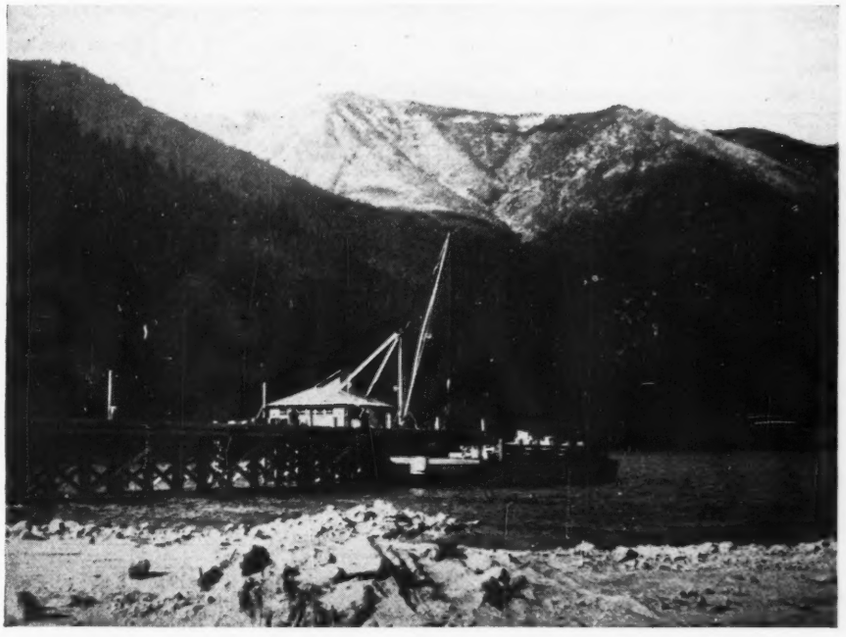
J. B. Huttl
Assistant Editor

WHAT IS EXPECTED to be the largest mining enterprise in the State of Washington, and one that promises to refute the general idea that no large mines can be developed in remote sections of the Cascade Mountains, is rapidly being prepared for production by the Howe Sound Company. The new enterprise has attracted considerable attention lately, and the work now in progress under the personal direction of C. P. Browning, general manager, with George C. Lipsey, general superintendent, in charge of operations, is followed with keen interest by engineers and mine operators because the latest methods are being employed in respect to developing a large mine in an area remotely situated and lacking rail transportation. Moreover, the property is in the heart of Chelan National Forest, and as a consequence the company had to adjust all operations and surface structures to the requirements of the Forest Service. A. C. Munro, general superintendent of mills, is in charge of transportation, general construction, and installation of mill equipment. All camp buildings are of a style that harmonizes with the rustic surroundings, and considerable study of climatic and soil conditions preceded the selection of the mill and tailings disposal sites. In the following account, based on notes obtained during a visit to the mine late in October, a general description of the new enterprise and what has been done to solve the difficulties mentioned and others imposed by an exceptionally rugged terrain, will be given.

The Holden copper mine is in the Chelan range, on Railroad Creek, and about 52 miles northwest of the town of Chelan, Wash. The trip thence is made by boat and truck. This service was daily, but it has been reduced to three sailings a week. The motor boat operated by the Lake Chelan Boat Company leaves Chelan at 8:30 a.m. and arrives at Lucerne, a small settlement on the western shore of Lake Chelan about 40 miles distant, around noon. From here the trip to the mine is made by truck over an excellent, company-built and -maintained highway 12 miles long. Materials and supplies unloaded at Chelan Station are brought to Chelan by truck, whence they are shipped on barges to Lucerne. Here they are transferred to 10-ton trucks and hauled to the mine. For this service the company has built piers at Chelan and Lucerne and maintains three wooden barges and a diesel tugboat, apart from a fleet of trucks operating between the mine and the pier at Lucerne. Both piers are built of wood, and the hoisting equipment consists of gasoline-powered cranes.

Since its discovery some 40 years ago, attempts to develop the Holden mine have been numerous. For a time the company formed by the discoverer, J. H. Holden, and known as the Chelan Transportation & Smelting Company, financed principally by European capital, had ambitious plans for the property, including construction of a rail line from Lucerne up to the mine, and a smelter at Chelan Station, on the Columbia River. A part of the mine railroad was actually built. The company failed at the start of the World War, and for a time Holden Gold & Copper Company carried on development work. Subsequently, the

LOOKING UP THE CANYON at the summit of the adjacent ridge. Beyond the substation at the right is the site for diverse buildings of the surface plant, including the repair shop, change house, and office



AT LUCERNE, on the western shore of Lake Chelan, 12 miles by highway from the Holden mine. All supplies for the property are received here by barge from Chelan, across the lake, to which point they are delivered by truck from Chelan Station on the railroad

property was taken under option or investigated by different companies and a limited amount of underground work was done intermittently. The present owners took an option on the mine late in 1928, and completed the purchase in 1932. Development began immediately, and underground work was carried on steadily until metal prices crumbled in 1931. During the summer of 1934, and again in 1936, the main haulage level, now known as the 1,500 level, was extended to intersect the orebody, following which a drift was driven along the footwall of the vein. This was followed by a diamond-drilling campaign to determine the size and extent of the orebody.

In the deposit, the ore occurs in metamorphosed sediments, probably Pre-Cambrian, and consists of an irregular lens. The ore itself appears to be of Mesozoic age. It is intruded by Mesozoic acid and intermediate intrusives, and the end products that have formed, have appeared as small dikes. There was considerable silicification with the deposition of the ore. With one exception, no major faulting has taken place. Minor movements, however, are numerous. The principal copper mineral is chalcopyrite. Other sulphides present in varying amounts include pyrrhotite, pyrite, sphalerite, and galena; also some gold. The strike of the orebody is S.35 deg. E., and it dips southwest between 65 and 75 deg.

The topography near the mine consists of a series of more or less parallel high hills, some rising to more than 8,000 ft., with narrow creeks between. Railroad Creek is a narrow canyon, its steep walls attaining a height of between 2,500 and 3,000 ft. above the canyon floor. The climate is fairly warm in summer, and winter temperatures are typical of those prevailing elsewhere in the Cascades. Elevation of the permanent camp now nearing completion is 3,280 ft., and that of the main mine entrance, the 1,500 level, 3,500 ft.

Development has gone forward on five levels, known as the 300, 550, 800, 1,100, and 1,500, which are 400, 1,000, 1,700, 2,400, and 3,000 ft. long respectively. The vertical distance between the two upper levels, that is 300 and 550, and 550 and 800, is 250 ft., and some 270 ft. and 377 ft. separate the 800 and 1,100, and 1,100 and 1,500 levels. To provide more flexibility in underground operations, particularly with respect to stoping, intermediate levels will be driven.

Early work indicated that the deposit was large and continuous, which subsequent development verified. Study of the orebody disclosed two factors: (1) that a large daily tonnage of ore could be mined cheaply by a combination shrinkage-bulldozing chamber method, and (2) that the most economical horizon on which to locate the main haulage level was the 1,500. Accordingly, all recent development work was laid out with these requirements in mind. This includes a short drift on the 1,500 level, whence a man and supply shaft, 9 x 13 ft. in section, is being raised to a point above the 550 level; four main raises, each 200 ft. apart and measuring 5½ x 11 ft., driven simultaneously from the 1,500, 1,100, and 800 levels, with drifting to the shaft; and some exploratory crosscutting and drifting to the internal shaft on the upper three levels. The 550 level will be the first mining level.

A 50-ft. surface pillar will be maintained above the workings to keep snow and water from entering the upper workings. All exploratory drifts are 6 x 7 ft. in cross-section. Exploitation of the desposit will be done by the so-called powder drift method of stoping. Explained briefly, it involves the establishment of a bulldozing chamber level, complete undercutting of a section of the orebody, and development of the block for employment of powder blasts. Ore is drawn off through the bulldozing chamber in the conventional

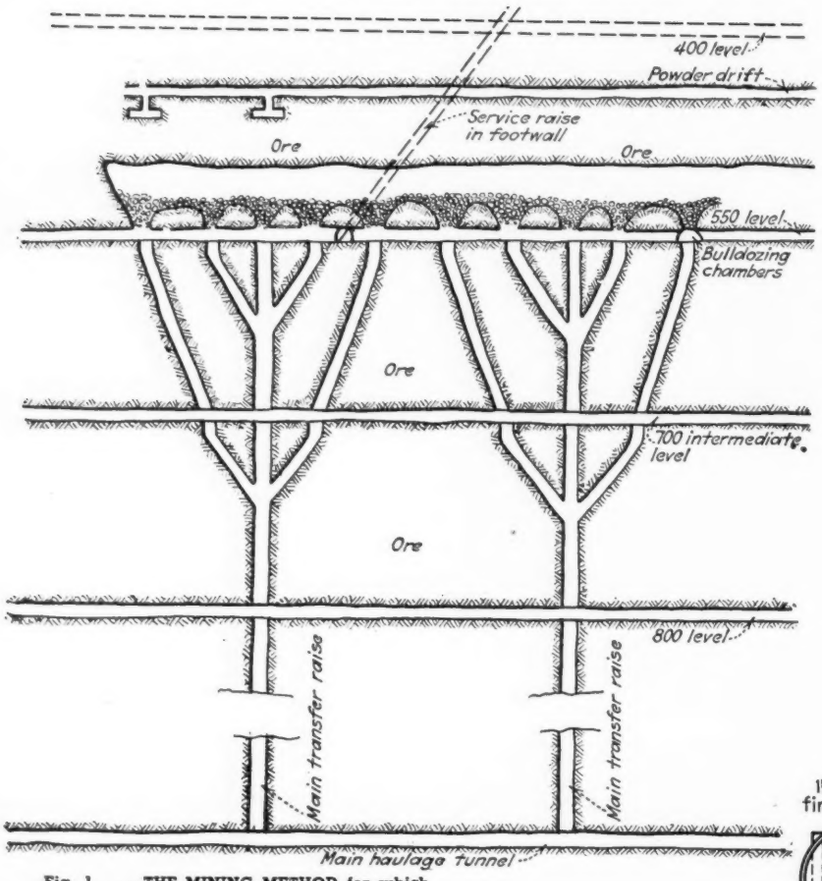


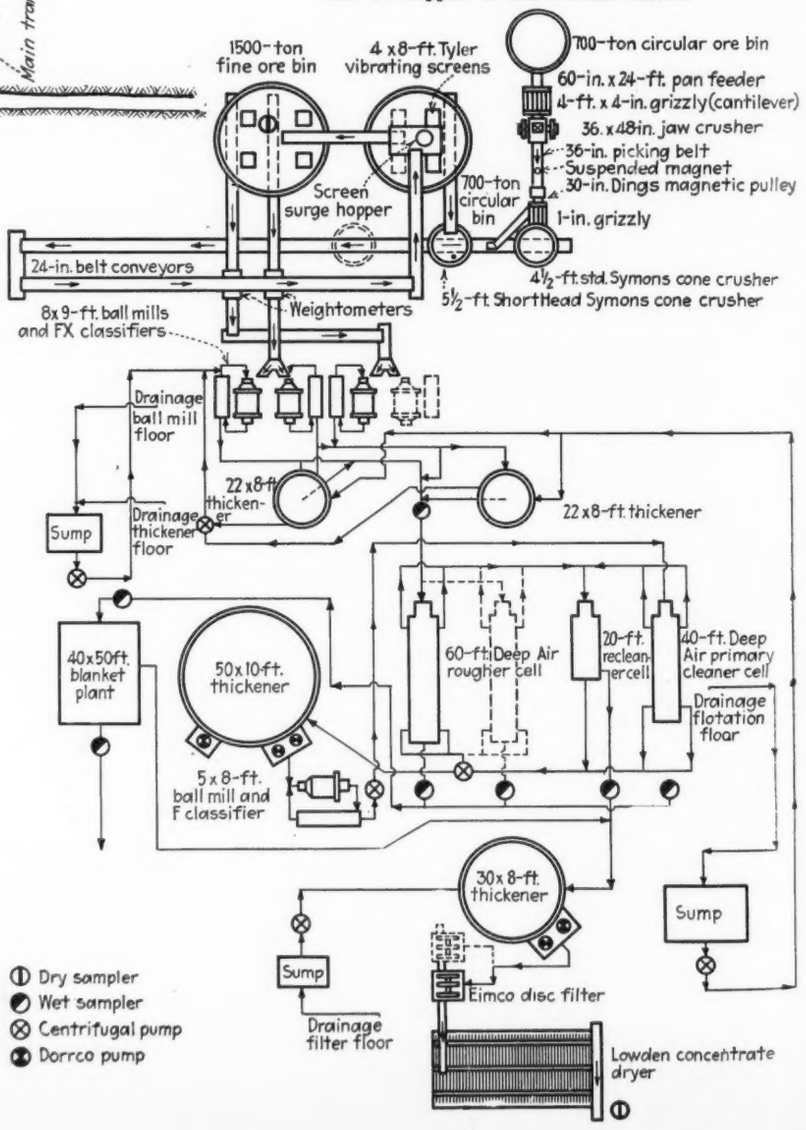
Fig. 1 . . . THE MINING METHOD for which the Holden deposit has been developed is indicated by this sketch, in vertical longitudinal projection. Daily production delivered to the mill is expected to exceed 1,000 tons

way. A section showing application of the method to the Holden orebody is given in Fig. 1. The bulldozing chambers will be spaced 40 ft. center to center and 15 to 20 ft. from the footwall itself.

As mentioned previously, drifts and crosscuts are driven 6 x 7 ft. in cross-section. Removal of broken material is done manually, though a Butler shovel is used where sufficient space is available. The ground is solid, and as a consequence little or no timbering is required underground. Ventilation is natural. On the 1,500 level ore will be hauled to the mill by G.E. locomotives drawing 130-cu.ft. Granby-type cars. Men and materials will be handled through the two-compartment internal shaft served by an electric-driven, single-drum hoist in the station on the 1,500 level. Most of the mining work done underground is carried out under a contract or bonus system. Daily production delivered to the mill is expected to exceed 1,000 tons.

The mill, repair shops, compressor house, office, and substation are near the portal of the main haulage level. All buildings are steel structures on concrete foundations linked together by a track system. The model change house contains the latest fixtures in respect to washbowls, showers, and storage of clothes. Each building will be heated by automatic oil-burning units. An interesting feature at the repair shops is the method of conveying equipment or materials to and from the mill building. This is done via a covered concrete tunnel extending from the shops to the incline on the side of the mill, the flat car operating on rails being actuated by an electric hoist. The mill building was fabricated and erected by the Isaacson Iron Works, of Seattle. It is of fireproof, steel construction and insulated throughout. Roof insulation consists of a 4-in. layer of Johns-Manville rock wool supported by Careystone board, and Thermax is used for the walls. The plant is designed to handle 1,000 tons of ore a day, but there is sufficient room for extra machinery should an increase in tonnage be contemplated in the future. Installation of equipment is done on company time.

Fig. 2 . . . FLOTATION following three-stage crushing and grinding to 65 per cent minus-200 mesh with classification will be used in the new 1,000-ton plant. The concentrate will be shipped to the Tacoma smelter



The concrete foundations of the mill and all surface plant buildings were erected under contract by Winston Bros., contractor, of Minneapolis, Minn. This company also reconditioned and widened the 12-mile road from Lucerne to the mine.

Complete preliminary laboratory tests were made at the plant of the company's subsidiary at Britannia Beach, B. C., Canada, the Britannia Mining & Smelting Company, Ltd. These tests were conducted by O. Wiser and H. A. Pearse, metallurgists, of whom the latter will be in charge of the new mill upon its completion early in 1938. Results of the work done so far indicate a recovery of 91 per cent, and the management is confident that this will be substantiated by the flowsheet shown in Fig. 2. As will be seen, the mine-run ore will be crushed in three stages to about ½ in., with a set of Tyler vibrating screens operating in closed circuit with the second cone crusher. A Traylor jaw crusher, a 4½-ft. standard Symons cone crusher, and a Symons Short Head cone crusher are available for this work. Grinding to about 65 per cent minus-200 mesh will be done in three Traylor ball mills and Dorr FX classifiers. Overflow from these machines will flow by gravity to two 22 x 8-ft. Dorr thickeners for conditioning before entering the flotation department containing a 60-ft. Deep Air rougher cell, a 40-ft. Deep Air primary cleaner cell, and a 20-ft. recleaner cell of like make. These machines were developed by the company and are giving good service at the Britannia concentrator.

Rougher tailings, after passing over a blanket plant, will go to waste, and concentrates, as well as those from the primary cleaner, are directed to the recleaner unit. The middlings from the rougher and primary cleaner cells and recleaner tailing will flow to a 50 x 10-ft. Dorr thickener, whence Dorrco duplex pumps will feed the underflow to a regrind unit consisting of a 5 x 8-ft. ball mill and a Dorr F classifier. Recleaner concentrates will be treated successively in a 30 x 8-ft. Dorr thickener, Eimco three-leaf disk filter, and a Lowden concentrate dryer. The primary cleaner tailings join those from the rougher cell, and recleaner tailings will go to the 50-ft. Dorr thickener mentioned previously. Overflow from the regrind classifier will be returned to the primary cleaner cell for further treatment. Dried concentrates are to be shipped to Chelan Station in covered containers, each of 5 tons' capacity, and thence in closed railroad cars to the Tacoma smelter. Tailings will be stored on a large tract of land cleared recently a short distance below the mill. This work also involved changing the creek bed. The modern laboratory and assay office is adjacent to the filtering plant.

The permanent camp is on the canyon floor, on which are now situated the temporary power and compressor plants, sawmill, warehouse, and the contractor's camp, and has been laid out in a gently sloping clearing close to the various plants so that the men may reach the mine, mill, repair shops, office, and other departments in from five to ten minutes' walk from their homes. So far, four dormitories, a mess hall, and twelve dwellings for married officials, visitors, and single members of the staff are under construction. All are of wood construction in a style in accord with the surrounding country. The exterior of each building is covered with shakes of contrasting colors. The mess hall is large enough to accommodate 264 men at one sitting, and kitchen, heating, plumbing, and lighting fixtures, as in all other buildings, are of latest design and construction. Besides hot and cold water, each room in the dormitories contains a radio connection and individual clothes storage for two.

Temporary power for current operations is furnished by a diesel plant containing two F-M units of 180 and 200 hp. respectively, and an 80-hp. diesel engine of Cummins make. The Washington Water & Power Company is now erecting a 50-mile power line, which is expected to be in operation in December. Electricity will be delivered at the mine at 110,000 volts, to be stepped down to 2,300 volts by the transformer station near the mill. Both power line and substation are equipped with modern safety and control devices to insure continuous and economical service.

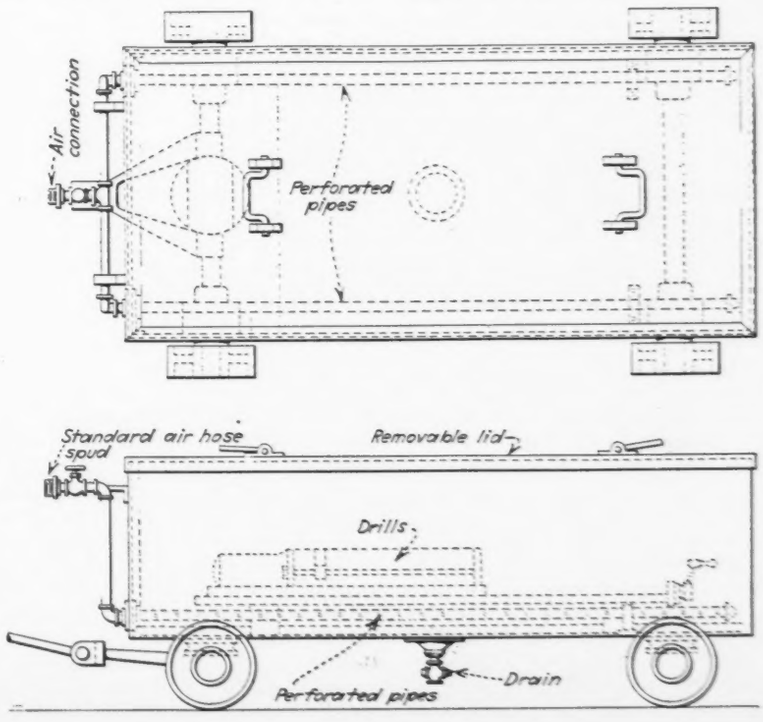
▼ ▼ ▼

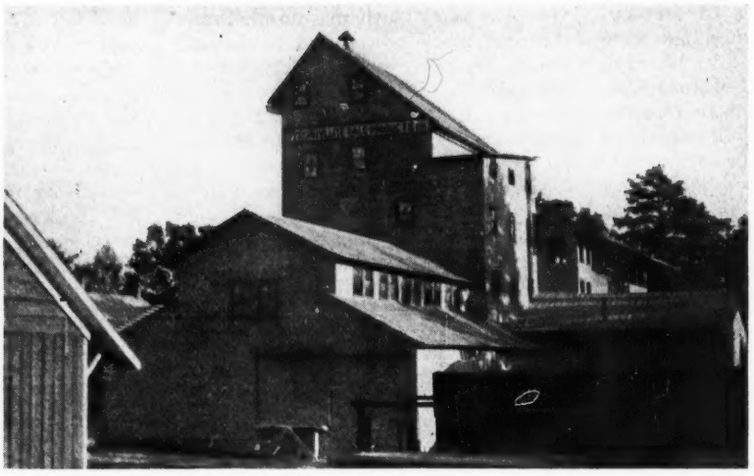
Quick Cleaning for Rock Drills

AN INTERESTING PIECE of equipment developed recently at the drill repair shop of Phelps Dodge Corporation, United Verde Branch, Jerome, Ariz., is a portable tank for cleaning rock drills removed from underground workings. Usually, these are delivered to the shop covered with dirt and sand and must be thoroughly cleaned by the repair man before being taken apart —a job requiring considerable time and patience, apart from the expense for brushes and rags. In the tank shown in the accompanying line cut preliminary cleaning of the drills is done with compressed air and kerosene.

As will be seen, the tank proper is made from steel plate reinforced with angle irons, and rests upon a simple four-wheel truck. Inside it are two steel brackets to support the drills, and two ¾-in. perforated pipes attached by flanges to the pipe manifold on the outside of the front end wall of the tank. Cleaning fluid, in this case coal oil, can be drained through the cock valve in the center of the tank bottom.

Operation is simple. The drills are placed into the tank filled up to the halfway mark with coal oil, then the lid is placed on the top of the tank and the air turned on. After about 15 min. the air is turned off, the drills are removed to the work bench, and the tank is made ready again.





GRINDING PLANT of Pyrophyllite Talc Products, Inc., at Glendon, North Carolina. It is equipped with a crusher of 100 tons capacity. Dry grinding with air separation is employed

Pyrophyllite Talc Mining Booms In North Carolina

Six grinding plants in operation . . . That at Glendon is described

WHEN THE DEPOSITS of pyrophyllite talc in North Carolina were first discovered is not definitely known. Dennis Olmstead, the first State Geologist, described the old Huronian slate belt and mentioned the talcose deposits in the Deep River area. His report was published by the State Geological Survey in 1825. Soon afterwards, a great deal of the material was used locally as tombstones, and in place of firebricks in chimney backs, and as hearthstones. The first recorded production of pyrophyllite was in 1850.

Pyrophyllite is a hydrous aluminum silicate. The true talc, or steatite, is a hydrous magnesium silicate. Chemically, the minerals are different, but physically they are similar. In products where the physical properties are the only criteria, these minerals may be substituted successfully for each other. However, where the chemical analysis determines the use, they cannot be substituted.

Until 1928, the production of pyrophyllite in North Carolina was of little importance, but today it is rapidly developing into one of the most important non-metallic mineral industries in the State. In 1928, only one small plant was in production. By the end of 1937, six grinding plants were producing pyrophyllite. One of these plants is owned by Pyrophyllite Talc Products, Inc., at Glendon, and at the time of writing this, was to begin production on or about Nov. 15, 1937.

The company named was organized in the summer of 1937 and purchased the talc property and grinding mill formerly owned by the United Talc & Crayon Company. Its property comprises approximately 80 acres, on which occurs a deposit of pyrophyllite 1,500 ft. long and in places 60 ft. wide, which has been drilled to a depth of 300 ft. Geologists have estimated the tonnage of recoverable material at 1,500,000. In addition to the main lens of pyrophyllite, prospecting has revealed two or three other lenses which may be of commercial importance in the future.

At present, the company is mining the pyrophyllite by open-pit method, and will continue to do so for some time. Overburden is removed by drag pan and overhead trolley. The pyrophyllite is drilled by hand, and in some instances where it is of exceptionally high grade, an ordinary hand auger is used. Inasmuch as the material is schistose and dips 35 to 45 deg., mining is done on the hanging-wall side. In drill holes, that are 5 or 6 ft. deep, only one or two sticks of 40 per cent dynamite is necessary to loosen the material so that it can be mined with pick and shovel. Because there are lenses of quartz and occasional streaks of talc containing a high per cent of chloritoid, a mineral high in iron which has to be removed, the material is mined by hand. However, the company plans to install a picking belt later so that the quartz and high-iron material may be picked out.

Miners are now being trained to sort the pyrophyllite by hand in the quarry, so that only a very high-grade product will be delivered to the mill for grinding. It is easy to distinguish between the high and the low grades on account of the differences in color. The high-grade product varies from white through shades of yellow to apple green, all of which, however, when ground gives a white product. Low-grade material contains considerable quartz and the color varies from dark brown to almost black. The black material often contains a high per cent of iron as well as varying amounts of graphite.

Accessory minerals are principally quartz, sericite, graphite, occasional cubes of pyrite, chloritoid, and occasional traces of limonite. The pyro-

phyllite often grades imperceptibly into sericite. It is impossible to distinguish between the two by megascopic methods, and only a trained mineralogist can do it with the microscope. This sericite is a variety of mica, which has a very silky luster and lacks the cleavage that the ordinary muscovite has. When the feldspathic rocks alter to muscovite rather than to clay, sericite mica is the common product. It has a high per cent of soda and potash, and therefore in chemical analysis can be easily distinguished from pyrophyllite. The accompanying table gives the chemical analyses of pyrophyllite and sericite.

As seen from these analyses, the pyrophyllite has very little soda or potash, whereas the sericite always shows very high per cents. Quantities of soda and potash lower the P.C.E. (pyrometric cone equivalent).

The mill of Pyrophyllite Talc Products, Inc., is $1\frac{1}{4}$ miles away on the main line of the Norfolk Southern, between Charlotte and Raleigh. The mill building is 150 ft. long, 60 ft. wide, and 65 ft. high. It is built of timber, with side walls and roof of galvanized metal and a concrete foundation. The engine room is built of concrete blocks, with floor of concrete on concrete foundation.

Four storage bins are provided for the crude material, each of a capacity of 300 tons. After the material is graded at the quarry, it is delivered to the plant by truck. A ramp permits the truck to dump directly into the crude storage bins. There are two bins for No. 1 material and two for No. 2. During rainy weather the wet material is dumped into the bins and air-dried before being ground.

Chemical Analyses of Pyrophyllite and Sericite

	Pyrophyllite Yellowish-white variety		Sericite	
Water (loss on ignition) H_2O	5.45	5.54	4.63	5.05
Silica, SiO_2	64.53	64.68	46.50	47.07
Alumina, Al_2O_3	29.40	28.34	33.91	36.89
Ferrous oxide, FeO	0.67	0.60	2.69	0.42
Magnesia, MgO	Trace	Trace	0.90	0.20
Soda, Na_2O	0.28	0.38	2.70	1.34
Potash, K_2O	Trace	0.01	7.32	8.21
Totals	100.33	[a] 99.55	98.65	[a] 99.18

[a] J. L. Stuckey, analyst.

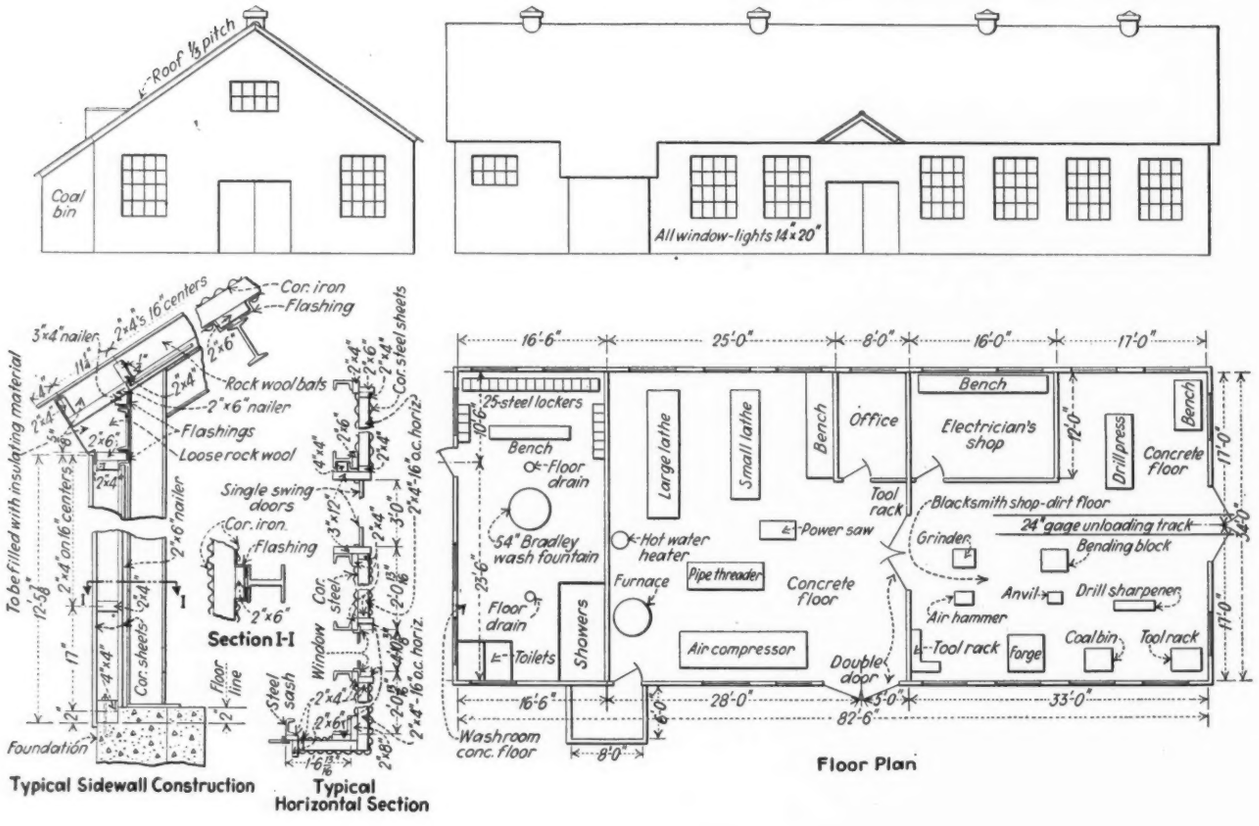
From the bins the material is fed by hand into a Sturtevant crusher of 100 tons' capacity. From this it is elevated to the primary storage bins, from which it goes by chute to a Raymond pulverizer, of three-roller design, which has a capacity of 3 tons per hour. The material is classified by air in closed circuit and the fines are sent to storage bins as finished product. Oversize is reground. From the storage bins the material is bagged by automatic machines, in paper bags of 80- and 100-lb. capacity. Material of any mesh desired by the trade can be produced. After being bagged, it is stacked in the stock rooms, of 40 carloads' capacity, from which it is loaded into cars on the siding.

The expansion of this mining industry has been due to the increased uses for the mineral in various trades. Up to 1929 the principal uses were in the manufacture of roofing paper, cotton cordage, toilet preparations, crayons and pencils, sheet asphalt, textile manufacturing, soap manufacturing, and in the rubber industry, the pipe-covering industry, and the bleaching industry. Since 1929, a great many others have been developed. Recent developments indicate that pyrophyllite has value in the manufacture of battery boxes.

Possibly the outstanding developments have been the results of experiments with it in the manufacture of ceramic products. It can be used as a substitute for Cornwall stone in wall-tile bodies. For this purpose it gives equal absorption, shrinkage, and modulus of rupture, greater uniformity over the firing range, and lower moisture expansion. In white tile it prevents crazing. Linear expansion and sensitivity to thermal shock are higher in the talc porcelain bodies than in ordinary types manufactured from feldspar and clay; and vitrified porcelain bodies containing 70 to 85 per cent talc are very tough but have a short firing range. Furthermore, the claim is put forth that pyrophyllite can be used in making firebrick, refractory cements, and plastics. This particular field is developing rapidly and considerable research is being done.

IN THE QUARRY at Glendon. Hand sorting is practiced to separate the high-grade pyrophyllite from the low-grade material. The two are readily distinguished

An Insulated Shop Building On the Cuyuna Range



DURING THE SUMMER of 1937 the shop building illustrated in the accompanying drawings was erected by Pickands, Mather & Company at the Mahnomen mine, at Ironton, Minn., on the Cuyuna range. Construction is of steel, with galvanized corrugated steel siding. The walls, exterior and interior, and the roof are filled with Johns-Manville rock-wool bats. Interior walls are also insulated to deaden sound. (This is not shown on the drawings.) The 2 x 4-in. members dress to about $3\frac{5}{8}$ in. The rock-wool bats fill the entire space. Their dimensions being approximately $3\frac{3}{4}$ in. thick, 15 in. wide, and 23 in. long, they fit nicely between the 2 x 4's on 16-in. centers. The corrugated galvanized sheets used are double-dipped, copper-bearing.

The type of construction described and illustrated is said to give a building that retains its heat in winter and is cool in summer. According to the manufacturer, the rock-wool bats have a conductivity of 0.075. A bat is $3\frac{3}{4}$ in. thick, it is claimed, has the insulating quality of a brick wall about 4 ft. thick.

Ball Mill Feeder Of Copper Resists Corrosion

THE BALL MILL FEEDER illustrated herewith is used at a large concentrator in the Southwest, where a section of the flotation department is operated on a natural circuit to treat economically an ore containing considerable copper sulphate, which is mined from an open pit.

Though corrosion of the walls and bottoms of the all-steel flotation machines and other auxiliary equipment was easily overcome by wood linings, certain ball-mill parts, especially the cast-iron feeders, subject to attack, presented quite a problem.

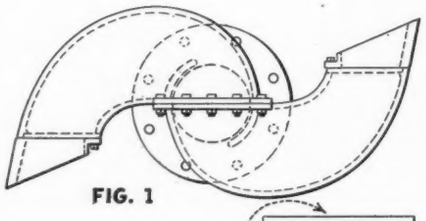


FIG. 1

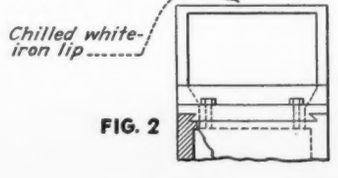


FIG. 2

As lining of the interior of the feeder with some special material was found both impracticable and costly, the problem was solved satisfactorily by using a feeder cast from blister copper. As is shown in Fig. 1, it is of sectionalized construction and contains two lips made from chilled white iron. The lips are secured to the scoop portions of the feeder in the manner shown in Fig. 2. Being carefully cast, the feeder parts and lips require little or no machining.

The Importance of Flotation At Alaska Juneau

Recovery of gold by this means from material formerly wasted exceeded $28,000 in last month of record. . . . Adoption of slimes treatment, successful in pilot plant, expected to increase this monthly saving by approximately $20,000

R. G. Hall
Consulting Metallurgist
Alaska Juneau Gold Mining Company, San Francisco, Calif.

TO EXPLAIN CLEARLY the present importance of flotation in the Alaska Juneau flowsheet, as well as the probable future extension of such operations, reference must be made to the detailed description given in the Alaska Juneau Enterprise Number of this magazine, published in September, 1932. On page 475 and following pages the milling methods and ore-treatment equipment employed are described by W. P. Scott, the mill superintendent. Further and earlier data are to be found in "Milling Practice at the Alaska Juneau Concentrator," presented in United States Bureau of Mines Information Circular 6236 in February, 1930, by P. R. Bradley.

The exact information in these two articles has been of great value in determining the lines which investigation should pursue, and the limits of commercial possibilities which could probably be attained by applying flotation to certain mill products. Mr. Scott's informative article will be worth rereading for those interested in a highly efficient milling operation that was giving a remarkably low cost; in fact, it is necessary to be familiar with the information presented therein to understand fully many of the references in the present article.

The laboratory of the Pan-American Engineering Company at Berkeley, Calif., was used for the earlier part of the flotation work, which was done by P. Malozemoff under the supervision of D. N. Vedensky, chief metallurgist of the company, and the general direction of myself. Investigation of the possibilities of the cyanide process was made by the same men, and the results were checked by the laboratory of the Merrill Company, of San Francisco. It is due the men who carried out this experiment to state that the detailed procedure which they laid down concerning grinding, reagents, and flowsheet has not, in the time the plant has been in operation, been changed in any important particular, and the flotation plant then recommended for handling 400 tons of feed is operating quite successfully on 700 tons.

Mill Feed—In 1936, 4,366,800 tons of ore, averaging 0.0422 oz. of gold of $1.477 gross value, was trammed from the mine. Of this 1,904,754 tons, assaying 0.0060 oz. gold, or $0.241, was rejected by the picking plant. The selected ore amounted to 2,462,046 tons, about 56.4 per cent of the total, assaying 0.069 oz., or $2.415. For the purpose of this paper it will be considered that 7,000 tons daily of this assay value is fine-milled. The ore is crushed in cone crushers, followed by rolls to 10 mesh or by ball mills to 7 mesh, depending on the class of material. Table I gives an approximate screen analysis, in even figures, with fractions eliminated.

Table I—Approximate Screen Analysis of Tonnage Milled in 1936

Mesh	Per Cent	Cumulation
10	4	4
14	10	14
28	22	36
35	10	46
48	7	53
65	5	58
100	7	65
150	5	70
200	4	74
—200	26	100

The feed described in the preceding is distributed to eleven ball mills—that is, one in each mill section. Auxiliary crushing machines contribute to the various sections in such a manner as to maintain delivery of a fairly equal tonnage to each one. Inasmuch as the ball- and tube-mill products are screened wet and there is no classification, the material sent to the rougher concentrators contains an unusual proportion of water.

Dewatering—The following description will cover operations after the introduction of the first flotation into the general scheme of the plant. A general description of one section in the rougher plant will answer for all eleven. The pulp passes through a one-spigot classifier, with the spigot sands going directly to four Deister roughers and the overflow passing into two V tanks in multiple. The spigots of the latter unite, and the pulp flows to four other Deister roughers. In general, the purpose of the classifier and V tanks is to dewater to such an extent as just to carry the sands to the tables, hence the overflow from the V tanks consists of low-gravity, low-grade slimes. Total overflow, gaged over a long period, amounts to about 4,000 g.p.m. or 25,000 tons daily, and contains 3.5 to 4 per cent solids, an average of 900 to 1,000 tons dry weight of slimes, practically all minus-200 mesh and assaying from 17c. to 21c. per ton. This material will be discussed in a later section.

Concentration—The eight Deister

tables have now remaining a total of about 550 tons, or less than 70 tons per table, and three products are made: (1) Concentrates, containing free gold, galena (silver mineral), pyrrhotite, pyrite with small quantities of chalcopyrite, sphalerite and possibly other minerals, and some gangue. This product contains 95 per cent of the gold ultimately recovered. (2) Middlings, containing mostly the coarser gangue material, pyrrhotite and pyrite, in about the order named. (3) Sands, with the remaining slimes which pass directly to the tailings launder and to waste. No further concern is given these at present.

Reconcentration—As mentioned previously, product No. 1 contains 95 per cent of the recoverable values in gold, silver, and lead, and amounts to about 125 tons for the entire plant per day. It is tabled, reground, and retabled, and the products obtained are: (a) bullion to the Mint; (b) lead, silver, and gold concentrates (gravity table) to the smelter; and (c) tailings, mostly pyrrhotite, some galena, and about $4 in gold. This product was formerly treated by flotation without regrinding. The result was a low-grade concentrate and a high-assay tailing. It is now sent to join product No. 2 from the roughers which forms the heads of the present flotation plant, and from 100 to 125 tons are available daily.

Flotation Feed—Product No. 2 or middlings from the roughers constitutes the feed for the first flotation plant. This material was formerly sent to Wilfley tables, which were efficacious in collecting such free gold and galena as had escaped the roughers. It is mostly the coarsest particles of the ore mixed with finer grains of the sulphides and still contains from $0.60 to $1 in gold alone. The amount was small at that time, only about 300 tons a day being taken out, but it was believed that a successful method of flotation would permit increasing the quantity greatly and add enough to the gross revenue of the plant to justify an installation.

Earlier efforts at flotation had been defeated by the peculiarities of the ore itself. The valuable mineral could be floated readily, but the concentrates contained so much low-grade pyrrhotite and barren carbon from the slate of the gangue that they would not pay freight and treatment charges. Pure pyrrhotite in the Alaska Juneau ores when ground to minus-100 mesh contains about $2.50, or about $0.04 in gold per unit of iron. There are also present considerable galena, pyrite, and some chalcopyrite, all of which are auriferous and must be recovered. The mixture confronting the flotation operator therefore was: (1) gangue—slate, quartz, and others—which when ground fine could be reduced to $0.06 gold; (2) carbon; (3) pyrrhotite, low grade, about $2.50 gold; (4) pyrite, sufficiently high in grade to be included in the concentrates; (5) chalcopyrite, very small in amount, but wanted in the concentrates; (6) sphalerite (marmatite) of no significance; (7) galena, argentiferous and auriferous. Native gold probably constituting about 90 per cent of the recoverable gold value of the feed.

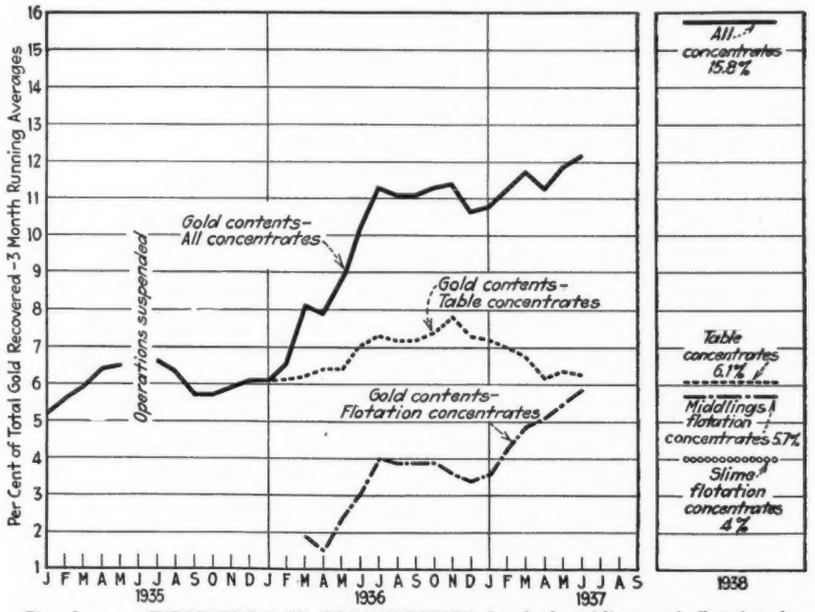

Per Cent of Total Gold Recovered - 3 Month Running Averages
Operations suspended
Gold contents - All concentrates
Gold contents - Table concentrates
Gold contents - Flotation concentrates
All concentrates 15.8%
Table concentrates 6.1%
Middlings flotation concentrates 5.7%
Slime flotation concentrates 4%
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
1935
1936
1937
1938

Fig. 1 . . . IMPORTANCE OF CONCENTRATION by both tabling and flotation in Alaska Juneau mill, relative to total gold recovery, is demonstrated by this graph. Four products are included: all concentrates, table concentrates, flotation concentrates, and slime concentrates

The gangue, of course, was eliminated by the xanthate rapidly and without difficulty. Fortunately, a colloidal depressant was at hand which was efficacious in removing both the carbon and the pyrrhotite, and this when used with care permitted the flotation of the economically valuable minerals. The need for making the highest grade consistent with good recovery made it desirable to clean and reclean. Actually, the ratios of roughing, cleaning, and recleaning have worked out to about 10, 10, and 4, or 5 to 1, so the final ratio became 500 to 1, and a $0.60 head yielded a $300 concentrate. In laboratory work a concentrate running 20 oz. in gold has been produced from a $0.60 head. The grinding determined upon was through 65 mesh, and at this grinding a tailing of $0.06 and a concentrate of better than $300 in gold were shown to be attainable. A $0.10 tailing was predicted.

Before final adoption of flotation many tests were made with cyaniding. In every case it was found that with the same grinding it was possible to make the same recovery of gold by cyanide as by flotation. Two factors influenced the final determination: (a) Flotation permitted a more compact plant which could be housed in space already available in the existing mill, and (b) flotation recovered sufficient lead and silver to pay transportation and treatment charges on the concentrate and to compensate for the smelter discount on gold. This offset the advantage of the cyanide process in producing bullion salable to the Mint.

Flotation Plant—After a pilot plant had demonstrated that the predicted results were attainable in practice, the plant was enlarged to handle a greater tonnage. Briefly, the flowsheet is as follows: Rougher middlings, or product No. 2, are sent to dewatering cones and direct to the grinding plant. Grinding is done in two ball mills, one 6 x 6 ft. and the other 6 x 9 ft., both being served by a Dorr classifier measuring 8 ft. by 23 ft. 4 in. Selection of the grinding units was entirely influenced by what could be fitted into an already crowded floor not originally designed for grinding machines. Further extension of regrinding, already a possibility, may necessitate more generous provision in space and more efficient machinery for this department. Classifier overflow, about 27 per cent solids, passes to a ten-cell Kraut rougher. The concentrate goes to a Kraut cleaner and the concentrate from that to M.S. recleaners. Tailings from these machines travel in reverse direction back to the rougher feed. This, of course, is all standard practice, as are the reagents and method of introduction. Consumption of reagents is unusually low, the cost being materially less than 2c. per ton, dry weight, of pulp.

As the practice has developed it was found advisable to add to the

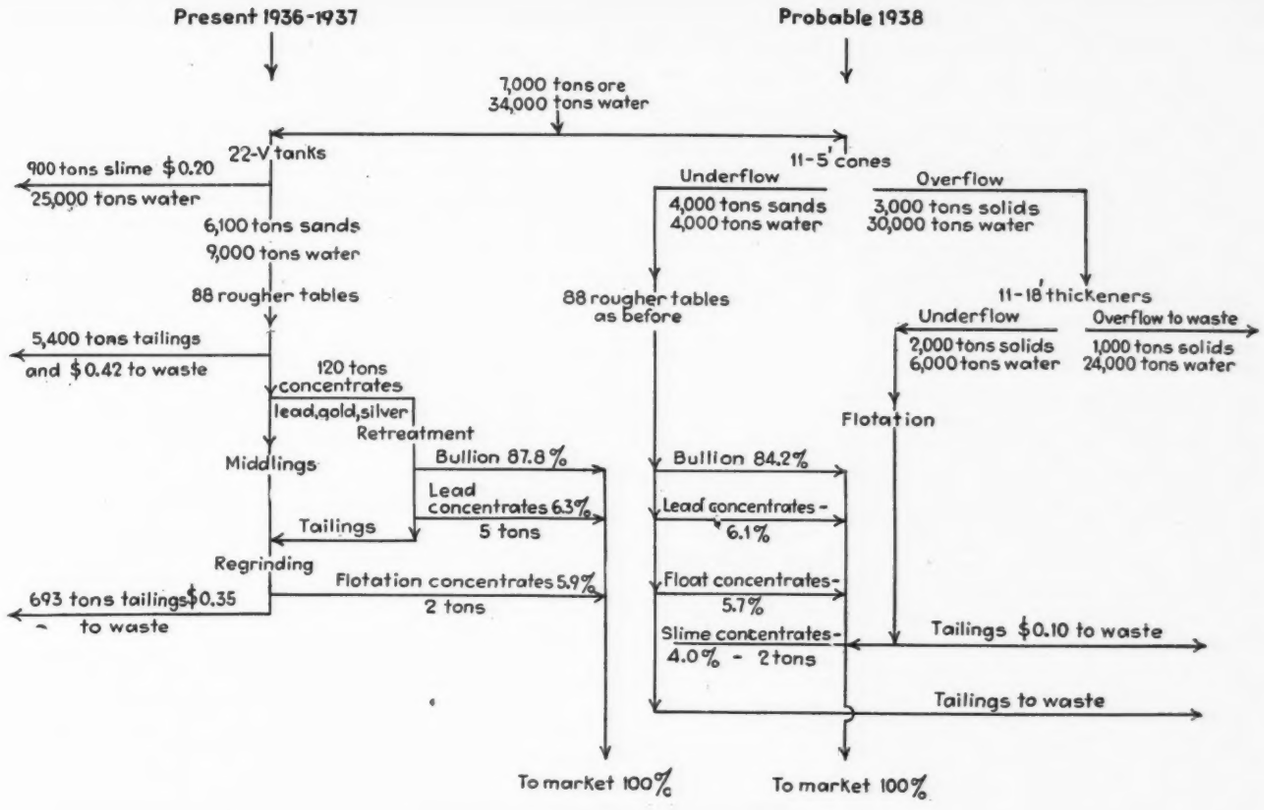


Fig. 2. QUANTITATIVE FLOWSHEET based on 7,000 tons of ore fine-milled daily. It is predicated on what has already been done and what is anticipated in line with the performance of the pilot plant

middlings regrinding circuit the retreatment tailings formerly floated separately. The result has been a material reduction in the gold contents of the final tailings from that source, without impairment of the efficiency of operation on the rougher middlings. It is interesting to note that the grade of flotation tailings from the recleaner tailings bears out the ratio of pyrrhotite to gold of about $0.04 per unit of iron. In this case 30 per cent iron gives a tailing of $1.25.

The tonnage put through the flotation plant originally intended for 350 to 400 tons of middlings now has been increased to about 600 tons, and is taking also from 100 to 125 tons a day of recleaner tailings. It is true that the flotation tailings are higher under the increased tonnage, but the total recovery has materially improved with practically no advance in the daily over-all cost of operating the plant, and the increased revenue is taken directly from what was going to waste.

From the original small plant operating on the recleaner tailings only and producing gross gold recovery of scarcely $2,000 a month, the flotation department showed in the last month of record at the time this article was written a total in gold recovery alone of more than $28,000, and this apparently without decreasing the recovery from the senior departments of the plant. The graph shown in Fig. 1 shows the importance of concentration, both table and flotation, relative to the total recovery of gold. To eliminate the inequalities of monthly clean-up, the curves are based on three months' average and plainly indicate the trend. The total gold production of Alaska Juneau Gold Mining Company for 1936 amounted to a little more than $5,000,000, so a new department which will increase this amount by 5 per cent out of formerly waste material is of importance.

Flotation of Plant Slimes—During the summer of 1936 an investigation was made to determine if it would be commercially and technically possible to recover the gold believed to be escaping with the slimes. In the sixth paragraph of this article I stated that the overflow from the V tanks amounted to about 25,000 tons wet pulp per day, 3.5 to 4 per cent solids, or 900 to 1,000 tons, of an assay value around $0.20, or 0.005 to 0,006 oz. per ton. No experimental work was necessary to determine that concentration was unlikely to yield any profit, and would certainly entail a considerable capital expenditure. Earlier experiments (1931) had indicated that if a desliming cone were used, a 6-ft. cone on each section would give an overflow of about 8 per cent solids of an assay value of 0.01 oz. However, the price of gold ($20.67) prevailing at that time did not promise much profit, and it was not until the advent of $35 gold that serious steps were taken to recover gold from the slimes on a commercial basis.

A classifying cone, having an overflow diameter of 6 ft., resembling the Caldecott, was built and installed on one section. The classifier and V tanks were bypassed. Performance of the cone was excellent, giving an overflow of about 90 per cent minus-150 mesh, and an underflow showing 95 per cent desliming. With an overflow averaging 50 c.f.m. per section at a density of 8 to 10 per cent, there was indicated for the plant a wet tonnage of 20,000 to 25,000 tons, and a dry weight tonnage of 2,000 to 2,500 tons assaying $0.40. Laboratory tests indicated that flotation would concentrate this either with or without thickening and make tailings of $0.12, with low reagent consumption. The large amount of water in the overflow, and the very dilute pulp, meant either (1) thickening, or (2) a considerable number of the largest commercial machines then known to be operating, or (3) development of a flotation cell of a volume far exceeding any hitherto built. To adopt thickening meant a large area of ground and building, pumping of pulp, and heating in winter, of which the first named was not available. The second of the possibilities seemed remote, as the space available in the present building was small and a large new addition was both difficult and financially uninviting. Work towards the development of a large-capacity flotation machine, occupying a minimum of floor space,

was undertaken to solve the problem. Developments to date have produced a machine measurably filling these requirements. A volumetric capacity of 150 to 200 cu.ft. per cell has been attained, with a reagent consumption of less than 2c. per dry ton and a power requirement of about 7.5 hp.

In the meantime a smaller cone, 5 ft. in diameter, has been installed on one section with a view of throwing over all sands as fine as 100 mesh, on the expectation that any gold that would rise in such a current would likely be too fine or too thin in one section to enter the roughing table concentrates. Experiments showed that the sands can be cut at about 100 mesh with considerable efficiency, and that the assay of the overflow pulp has been increased. This throws into the new flotation circuit gold which hitherto was sent to the tables, and, being too fine or too thin, passed off into the table tailings to waste. After removal of the V tanks it was found possible to install a thickener 18 ft. in diameter and of low headroom. Until now, this thickener, though not giving a clear overflow, has proved itself about equal to the former V tanks. The overflow from the 5-ft. cone now goes to this thickener, the thickener overflow of about 4 per cent solids and $0.20 grade going to waste. Thickener underflow can be controlled to 25 or 30 per cent solids of a grade averaging $0.50 and so much reduced in volume that it can readily be treated in commercial machines.

This one-section pilot plant, which is now being extended to include the whole plant, gives reason to predict about 2,000 tons of heads that should produce, when complete, tailings of $0.09 to $0.12, and a recovery of about $0.35, or about $20,000 per month for the plant, from material now going to waste. Inasmuch as there is no grinding to be done, the principal operating expenses will be those for reagents (less than 2c. per ton) and power, which is not high.

Based on 7,000 tons daily fine-milled, a quantitative flowsheet (Fig. 2) can be made partly on what is already done and what is anticipated in line with the performance of the pilot plant. After the complete installation of a slime flotation plant, there will still remain some 4,000 tons of sand tailings of low value now going to waste without further treatment. To what extent this may admit of further profitable treatment cannot yet be determined. In the coarse end, or middlings, the tonnage taken has already been materially increased. As better and greater grinding facilities are possible, this can, no doubt, be profitably extended to include some material other than middlings. Any material drawn from the coarse end of the table requires regrinding and must be of a grade to pay this cost.

Assuming that the desliming cones as installed will send over all minus 100-mesh material, it may be found possible at a later time so to adjust these as to send over more of the intermediate sizes without taking over metallic gold, which economically should be sent to the tables and thence direct to the amalgamating plant. Metallic gold in a flotation concentrate as produced here cannot readily be amalgamated, and hence must be marketed indirectly, and consequently with less advantage, through the smelting plant. Predictions in metallurgical matters are usually unsafe, but in this case it is quite possible that all the tailings from the fine milling plant will eventually pass through some form of flotation plant before reaching the tailings launder.

▼ ▼ ▼

A Tractor in Durango

SAN LUIS Mining Company conducts its operations at isolated Tayolta, Durango, Mexico. The railroad station from which supplies and equipment must be hauled is Dumas, Sinaloa, 100 miles distant. Airplanes are used for outgoing gold and silver bullion, but incoming supplies are transported by tractor over the rugged terrain of a river bed.

At the start the company used pack mules on a winding trail around the steep mountains flanking the Piaxtla River. Costs ran from a minimum of $25 to as much as $200 per ton. Pipe and lumber had to be cut into 10 ft. lengths, and heavy machinery had to be sectionalized into packages of size and weight that could be handled by one or two mules. When it became necessary a year ago, however, to install a 450-hp. diesel engine to supplement the hydro-electric power on which the mine and mill relied, it was obvious that pack mules must be abandoned in favor of some other method of transportation. Time and money had to be conserved if the job were to be done economically. Accordingly, the company bought a Caterpillar 60 tractor and put it on the job hauling track-type wagons. Twenty-eight days were required for the first trip, but time and costs were reduced compared with mule trains. In three trips the machine had saved its cost, and the method of hauling supplies to the mine had been revolutionized.

Subsequently, the company replaced the first machine with a 95-hp. Caterpillar diesel tractor which hauls track-type wagons. The route follows the bed of the Piaxtla River for the entire 100 miles, in the course of which the train must crawl over boulders, through river sand and mud, and occasionally through several feet of water. An average of seven days is required for the round trip of 200 miles. Two drivers and four helpers work in alternate shifts, and the caravan is usually on the move from 16 to 18 hours daily. For the comfort of the men the mining company has introduced an ultra-modern note in the form of an automobile trailer which is attached to the end of the train. This trailer was one of the first shipped into Mexico, and before it was delivered photographs were sent to the Mexican Government so that tariff rates could be set.

The tractor and its train coming down the bed of the Piaxtla River

The hauling season starts in December and ends in June, at which time high water makes the river route impassable. Flood waters materially change the bed of the river and necessitate the annual establishment of a new route. For this purpose the tractor is equipped with a cable-controlled bulldozer for pushing aside the largest boulders. Blade and side arms are removed during the regular hauling season, but the frame is left mounted on the tractor to serve as a crane to hoist a mired trailer wagon and carry it onto better ground. At the opening of the season, however, tractor and bulldozer spend from 20 to 30 days feeling out a new trail, planning the safest crossings, and otherwise making a passable route. During the season of the year when tractor hauling is impossible, the machine and bulldozer are used for the construction of roads and general improvement of the mine property.

"Velocity of Hit" In Rock Crushing

Study of results with drop-weight apparatus shows this factor to be important

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Professor of Metallurgy

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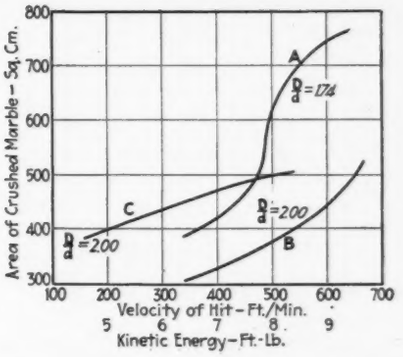


Fig. 4 . . . RESULTS obtained with glass marbles. These curves show that in the range investigated the amount of surface formed is directly proportional to the kinetic energy of the crushing shoe (curve C) and that it tends to increase rapidly with increasing velocity of hit up to 600 ft. per minute

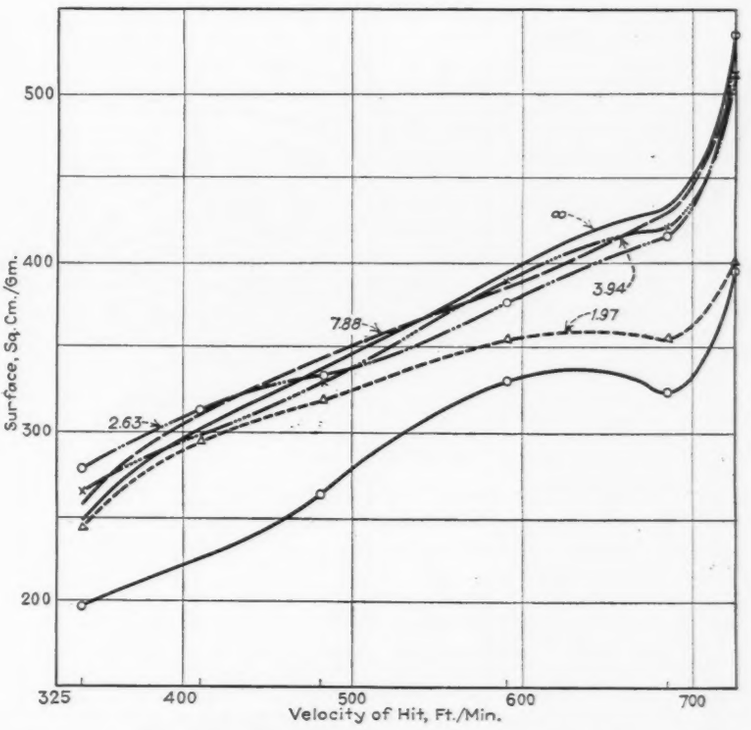


FIG. 5 . . . NEW SURFACE produced with a 4.59-lb. shoe has been plotted against velocity of hit in drawing these curves. Five curves for Ottawa sand and one curve for garnet sand (the lowest) are shown

II. *AT THE OUTSET of the tests here described, attention was directed to experimentation with the rolls crusher, this line of investigation being abandoned temporarily after some months when such approach to the problem was found unsatisfactory. This phase of the research was dealt with in Part I, published in the December issue; likewise the results obtained with drop-weight crushing apparatus specially devised subsequently. The latter results form the basis of the following discussion:*

THE RESULTS OBTAINED on glass marbles are shown in Fig. 4. In all cases the ordinate is surface produced; the abscissa for curves *A* and *B* is velocity of hit in feet per minute, and for curve *C* kinetic energy in foot-pounds. Curves *A* and *B* are from the data in Tables IV and V respectively; here the height of drop was varied and the weight of the shoe held constant (4.36 lb.). Reduction ratio was 1.74 in curve *A* and 2.00 in curve *B*. In making the tests recorded in Table VI (curve *C*), a constant height of drop (consequently a constant velocity of hit) was used but with variable weights of the falling shoe.

The curves show that in the range investigated the amount of surface formed is directly proportional to the kinetic energy of the crushing shoe (curve *C*), and that the tendency is for the amount of surface produced to increase rather rapidly with increasing velocity of hit (curves *A* and *B*) up to a velocity of around 600 ft. per minute, where the curves begin to flatten out. There is considerably more surface produced for a given velocity of hit (and given kinetic energy) for a reduction ratio of 1.74 than for a ratio of 2.00 (curve *B*).

Fig. 5 shows the new surface in square centimeters per gram plotted against velocity of hit. There are five curves for Ottawa sand for five different ratios of reduction, and one curve is shown for garnet sand. The small figures adjacent to the curves indicate the ratio of reduction.

It will be noted that the amount of surface produced increases steadily until a velocity of about 700 ft. per minute is reached, and here the curves begin to rise much more rapidly. The curve for Ottawa sand with a ratio of reduction of 1.97 lies below the other curves; the four other curves are bunched together and practically coin-

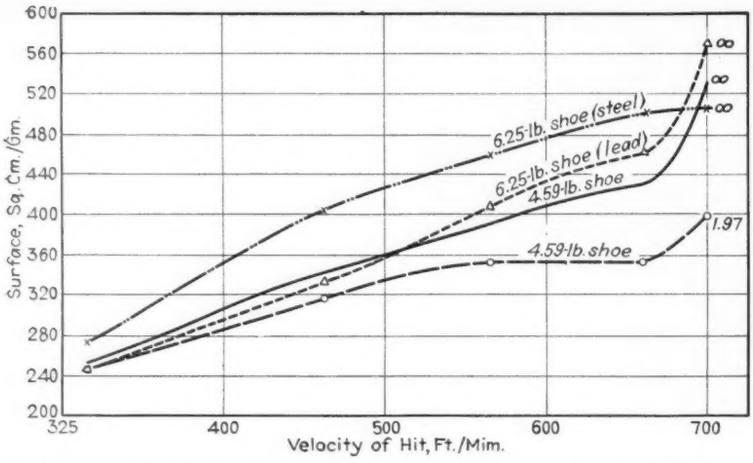


Fig. 6 . . . THREE DIFFERENT SHOES were used in obtaining the data for these curves, as indicated. Ottawa sand was used in each of the four tests

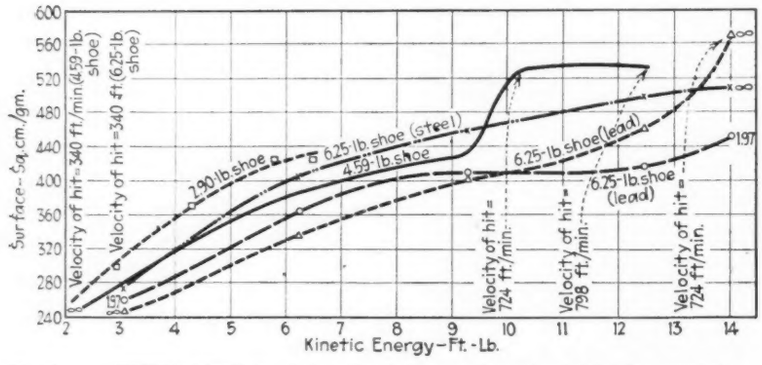


Fig. 7 . . . KINETIC ENERGY of the shoe has been plotted against the amount of new surface formed, in drawing each of these curves. The weight and kind of shoe vary

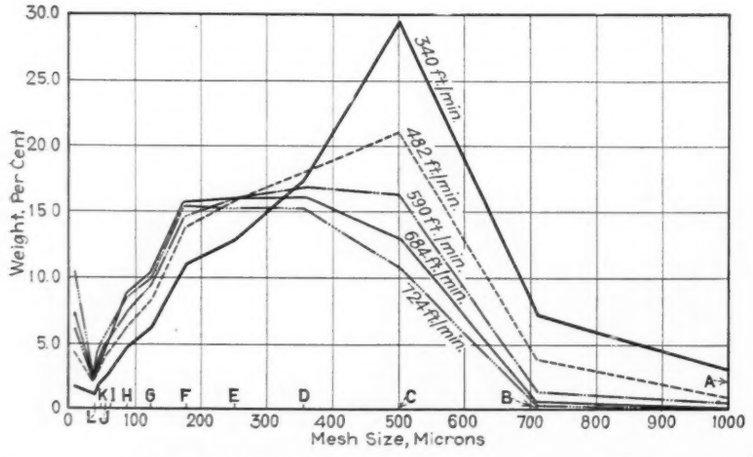


Fig. 8 . . . SIZE DISTRIBUTION of the material crushed by a 4.59-lb. shoe at various velocities of hit is shown by these curves. Ottawa sand was used in each case. The reduction ratio is infinity; that is, no set ring was used. Here the weight per cent of each size has been plotted as ordinate

cide at velocities of about 724 ft. per second. It would appear that the ratio of reduction has little effect on the nature of the crushed product for this particular weight of shoe with the exception of the ratio of 1.97. The reason for this is not clear, but it will be noted that the break in the curve occurs at practically the same velocity of hit as in the case of the four upper curves. Although the garnet curve represents a different substance and a different particle size, the curve has the same general appearance as the other curves and shows a break at the same point.

The sharp breaks in these curves are particularly interesting, and as yet we have no definite explanation for them. It was noted in experimenting with the 4.59-lb. shoe that at a velocity of hit of 724 ft. per second the shoe rebounded noticeably after striking the die, but at lower velocities there was not appreciable rebound. Inasmuch as this effect coincided with the sudden increase in surface of the crushed material, it was thought that the sharp breaks in the curves might be connected with the rebound of the shoe. Subsequent tests, however, seemed to indicate that this was not the case.

In Fig. 6 there are four curves for Ottawa sand crushing, using three different shoes. As noted in Fig. 5, the curve for a ratio of reduction of 1.97 lies below the curve for a ratio of infinity (no set ring), but the curves are similar in appearance and show breaks at the same point (these curves are those for the shoe weighing 4.59 lb.).

Of interest are the two curves for the 6.25-lb. shoes. The "lead" shoe was made by placing an annular disk of lead weighing 1.66 lb. over the top of the 4.59-lb. steel shoe to give a shoe having a total weight of 6.25 lb. The lead disk was not fastened to the steel shoe, but simply rested on the shoulder formed by the lower part. After completing a series of tests with this shoe, it was noticed that the soft lead disk was deformed as if the steel shoulder had been driven up into it; evidently some of the kinetic energy of the shoe was being consumed in the plastic deformation of the lead. The "steel" shoe weighing 6.25 lb. was made by fitting an annular steel disk over the 4.59-lb. steel shoe, and fastening it firmly with machine screws. The weight of the steel disk and screws was such that the total weight of the "steel" shoe was 6.25 lb.

As will be noted in Fig. 6, the effect of the 6.25-lb. "steel" shoe is different from both the 6.25-lb. "lead" shoe and the 4.59-lb. "steel" shoe. The curve lies well above the other two for most of the range and is uniformly curved with no sudden break at any point. Curves for the 4.59-lb. shoe and the 6.25-lb. "lead" shoe are remarkably similar; they lie close together and show a break at the same point. In fact, it appears that the addition of a 1.66-lb. lead weight has very little effect on the 4.59-lb. shoe. In spite of the increase in kinetic energy, the amount of surface produced does not increase very much (it is actually less at low velocities), and, what is even more peculiar, the characteristic "break" in the curve is still present and occurs at the same point. In this series of investigations, the "break" was always found whenever the 4.59-lb. steel weight was used, regardless of whether it had a lead collar resting on it or not. In the range of velocities studied, no similar break was ever

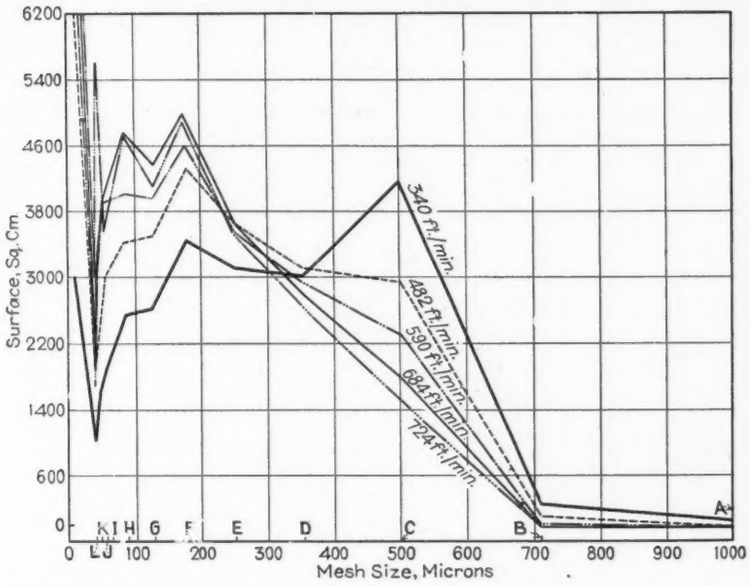


Fig. 9 . . . SIZE DISTRIBUTION at various velocities of hit under the same conditions as in Fig. 8 is shown here. These curves differ from those in Fig. 8 in that in this case the surface in square centimeters has been plotted as the ordinate

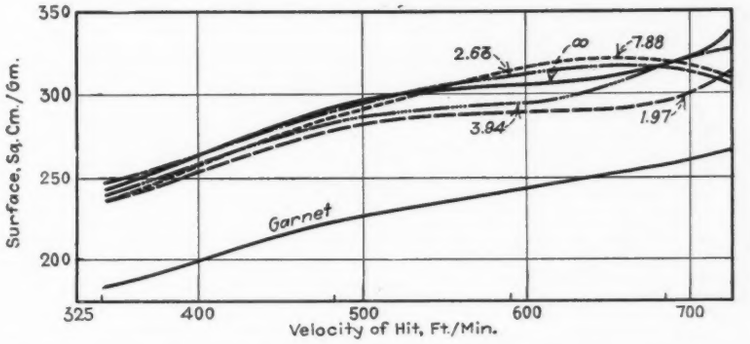


Fig. 10 . . . ONLY THE PLUS-400-MESH surface produced with a 4.59-lb. shoe has been plotted against velocity of hit in drawing these curves. Save for the surface data used in plotting, the graphs are the same as those shown in Fig. 5

found for the solid steel shoes, either lighter (2.90 lb.) or heavier (6.25 lb.) than the 4.59-lb. shoe.

Data presented in Fig. 6 also seem to disprove the hypothesis that the break in the curves might be related to the rebound of the shoe. The 6.25-lb. "lead" shoe showed no noticeable rebound at any velocity, but the break in the curve still appeared at about 700 ft. per minute. On the other hand, the 6.25-lb. "steel" weight began to show considerable rebound at velocities as low as 482 ft. per minute, but there is no corresponding break in the curve.

In Fig. 7 are shown several curves in which the amount of new surface formed is plotted against the kinetic energy of the shoe. The lightest shoe of all (2.90 lb.) shows the greatest amount of surface produced for the expenditure of a given amount of energy, and up to about 9.5 ft.-lb. the 6.25-lb. steel shoe produces more surface than the 4.59-lb. shoe. After the "break" in the curve, however, the curve for the 4.59-lb. shoe rises above the curve for the 6.25-lb. steel shoe. An additional test was made with the 4.59-lb. shoe at a velocity of 798 ft. per minute, and the amount of surface formed was the same as that found for a velocity of 724 ft. per minute.

Figs. 8 and 9 show the size distribution of the crushed material made by the 4.59-lb. shoe at various velocities of hit. In Fig. 8 is plotted the weight of each size, and in Fig. 9 the surface is represented by each size. As the velocity of hit increases, the maximum point moves steadily toward the left (smaller size) and the amount of very fine material (minus-400 mesh) increases.

Fig. 10 is the same as Fig. 5 except that only the surface represented by the plus-400 material is plotted. In Fig. 11, there is plotted the weight of minus-400 mesh material produced in each test. These figures indicate that the sudden increase of surface denoted by the "breaks" in the curves in Fig. 5 are due almost entirely to a disproportionate increase in the amount of minus-400 mesh material formed.

Fig. 12 is the record of two special tests made to confirm certain points brought out by previous tests. Curve *A* was obtained by varying the velocity of hit, but keeping the total kinetic energy constant (by using the proper weight of shoe in each case). The results of this test seem to indicate the same thing noted in Fig. 7—that for a given amount of kinetic energy more crushing is done by a light, speedy blow than by a slow, heavy blow. The shoes used in this test were all "steel" shoes.

According to Rittinger's Law, the amount of surface produced should be directly proportional to the kinetic energy expended. Fig. 7, however, shows that in general there is less surface produced than Rittinger's Law predicts. As these tests were not designed to measure the absolute efficiency of crushing, the total kinetic energy of the shoe was plotted, and no corrections were made for rebound or deformation of the die and shoe. From the data in Table VII, the values in Table VIII were calculated for the amount of surface produced per kilogram-centimeter of energy, using the 4.59-lb. shoe with no set ring.

The amount of surface produced per unit of energy drops off as the velocity of hit increases. Gross and Zimmerly[5] obtained an average value of 17.56 sq. cm. per kilogram-centimeter when crushing quartz with a drop-weight crusher; they made allowances for the energy dissipated in rebound of the weight and in deforming the die.

It was thought that perhaps the decrease in the amount of surface produced per unit of energy as the velocity increased might be due to the fact that insufficient quartz was present at the higher velocities to absorb all of the available energy properly. With this thought in mind, a series of tests was made at variable velocities of hit, using a 4.36-lb. steel shoe without a set ring, and increasing the amount of sand to be crushed in each test so that the weight of sand was proportional to the kinetic energy of the shoe. The results of these tests are shown by curve

Table VIII—Surface Produced per Kilogram-Centimeter of Energy

Velocity of hit, feet per minute.....	340	482	590	684	724	798
Sq. cm. per kg. cm.....	7.87	5.32	4.16	3.40	3.71	3.02

[5] Crushing and Grinding, III: A. I. M. E. Tech. Pub. 127, 1928

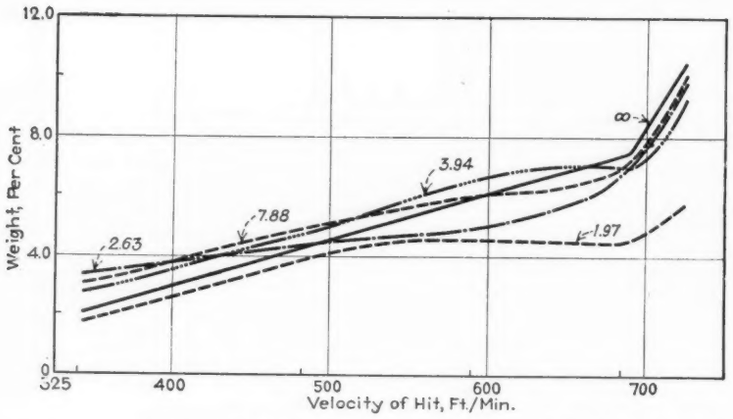


Fig. 11 . . . THE WEIGHT of new minus-400-mesh material produced in each test has been plotted against velocity of hit to give these curves. A 4.59-lb. shoe was used

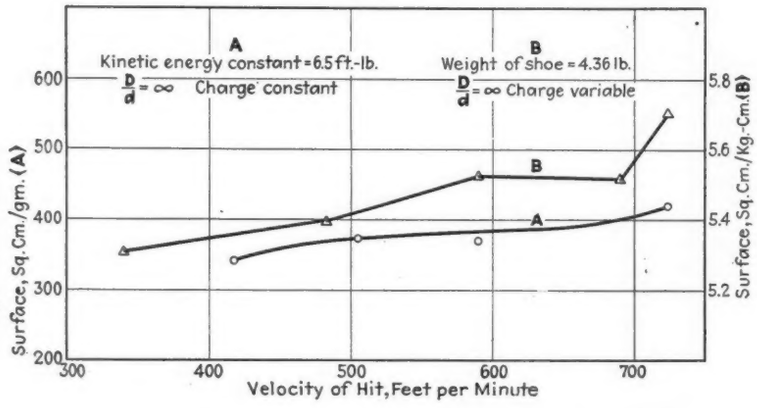


Fig. 12 . . . GRAPHS indicating results of two special tests that were made to confirm those obtained in earlier ones. Curve A was obtained by varying the velocity of hit but keeping the total kinetic energy constant. Curve B was made by varying the velocity of hit but keeping the weight of sand used in each test proportional to the kinetic energy of the shoe

B, Fig. 12. Under these conditions, the surface produced per unit of energy increases as the velocity of hit increases. This curve also shows the same abrupt rise at velocities of about 700 ft. per minute. (This shoe did not differ greatly in weight from the one used previously—4.36 lb. as compared with 4.59 lb.).

Velocities of Hit in Commercial Crushers—In connection with the data given above, it is interesting to tabulate the velocity of hit of a few common types of crushing machines.

Velocity of hit of stamps is calculated by applying the law of falling bodies just as was done for the drop-weight crusher. The most common height of drop for stamps is 7 in., and this drop gives the shoe a terminal velocity of 375 ft. per minute.

Velocity of hit for roll crushers is calculated by determining twice (inasmuch as there are two rolls) the horizontal component of the velocity of a point on the roll face just as the particle is nipped between the rolls. This velocity of hit will depend both on the angle of nip and the peripheral speed of the rolls. A few typical examples are tabulated in Table IX.

Table IX—Velocity of Hit for Roll Crushers

Diameter of Rolls in Feet	R.p. M.	Angle of Nip	Velocity of Hit, Feet per Minute
2.5	108	13 deg. 24 min.	198
3.0	90	19 deg. 00 min.	284
3.5	90	17 deg. 36 min.	304
4.0	65	15 deg. 36 min.	220
4.5	92	23 deg. 54 min.	540
6.0	72	17 deg. 00 min.	400
		Average.....	324

In a cone crusher, we may consider a point on the crushing head alternately approaching and receding from the bowl liner. Such a point has a simple harmonic motion with a maximum velocity at the midpoint of its path and zero velocity at each end. Knowing the number of gyrations per minute and the length of the stroke, we can calculate the velocity of hit at any given point. In Table X are a few typical examples for cone crushers.

Conclusions—For the range covered by the preceding experiments, we may draw the following conclusions relative to the effect of velocity of hit on crushing:

1. The velocity factor is undoubtedly of considerable importance in crushing operations, inasmuch as it affects both the nature (size distribution) of the crushed product and the efficiency of crushing. In any crushing operation, some of the kinetic energy of the moving shoe, roll face, or crushing head must be transferred to a rock particle by impact. This energy then deforms the particle beyond its elastic limit and causes a certain amount of fracture, and it appears that the rate at which this energy is transmitted to the particle has considerable influence on the nature and extent of the crushing done.

2. In the tests made on Ottawa sand, the "set" of the crusher did not seem to have much effect. The few tests that were made on the relatively large glass marbles seemed to indicate that this might be of more importance in crushing large particles.

3. For a given amount of feed, using shoes of different weights, it appears that a light, high-velocity blow does more crushing than a heavy, low-velocity blow of the same kinetic energy.

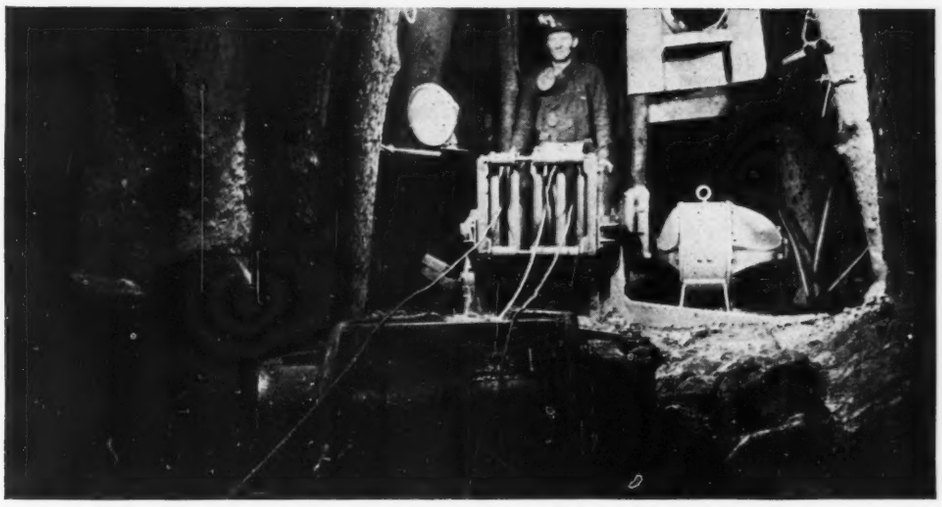
4. When the amount of feed is kept constant, the amount of new surface produced per kilogram-centimeter decreases as the velocity of hit increases. If, however, the amount of feed is proportioned to the kinetic energy of the shoe, the surface produced per unit of energy increases with the velocity of hit.

5. High velocities of hit produce a crushed product of more uniform size distribution than do low velocities of hit, and as the velocity of hit increases the maximum point on the distribution curve moves toward the smaller sizes. High velocities of hit tend to produce abnormally large amounts of very fine particles.

(*Continued on page* 52)

Table X—Velocity of Hit for a Cone Crusher

Size of Cone, Feet	R.p. M. of Head	Set, In.	Open Position, In.	Velocity of Hit, Feet Per Minute	
				Average	Maximum
3	290	⅛	2⅜	109	170
4	243	⅛	2½	146	151
4	243	¼	3¼	122	191
5.5	243	⅜	4⅜	162	254
7	218	⅜	5¼	177	278
			Average.....	133	209



THREE-DRUM SCRAPER HOIST, driven by a 35-hp. motor and operating a hoe-type scraper in the Lake Superior Iron Country

Automatic Circuit Breakers For Scraper Hoist Motors

Found to give better protection than the use of fuses

J. M. Leonard
Westinghouse Electric & Manufacturing Company
Duluth, Minn.

WITH THE INCREASED USE of the electric slusher hoist in underground mining operations, the protection of the hoist motor has received attention, due to armature burn-outs caused mainly by stalled scrapers and exceptionally high sustained peak loads which approach the stalled current condition. Some operations have turned to thermally operated automatic circuit breakers as a solution of this problem, materially reducing armature failures.

Where the condition of extremely high relative humidity is met in underground mines with the presence of corrosive salts in solution in the mine water, the sheet-steel inclosures of the control equipment tend to corrode, with the formation of a chemical precipitate on the contacts of the fuse holders, causing high resistance contact. Events have proved that the use of fuses in the underground operations was not the most satisfactory protection to the slusher hoist motor.

Approximately three years ago, a few mines installed some automatic circuit breakers, replacing the fused safety switch on their slusher hoists. The first of these worked so well that these mines installed a circuit breaker with each new hoist, and began a program of replacing a number of fused switches with breakers each month, until all of their hoists are now equipped with these De-ion breakers.

The breaker was originally developed to give individually inclosed circuit-breaker protection for main services, light, and power wiring systems. In using it as a motor-starting switch, it is required to operate both manually and from overcurrent approximately six to ten times a day. Obviously, this requirement is more severe than that of a breaker protecting a feeder circuit which is operated perhaps not more than once a month.

The breaker, when inclosed in a cadmium-plated, dust-resisting steel inclosure, has withstood such severe operating service and corrosive humid underground atmosphere satisfactorily. Metal parts and bearings are corrosion resistant, the contacts are made of special non-welding non-oxidizing materials, and the operating toggle mechanism is "trip-free" of the handle in all positions and is of the "quick-make" and "quick-break" type. The tripping mechanisms are protected and sealed to prevent tampering with calibration.

For slusher hoist service, a 100-amp., 250-volt, d.c., two-pole circuit breaker is used. The trip unit nearest the full-load current rating of the motor and which will permit the starting current inrush of the motor has been found most suitable for this application. Although the breaker does not give as close protection to the motor as an overload relay, it does give ample protection against excessive peak loads and stalled scraper conditions.

Where a three-phase a.c. induction motor is used, a three-pole breaker is employed. Over-current in any one of the three poles will open all three lines to the motor, because all the operating fingers are attached to a common operating crossbar, which is actuated by a common tripping unit. This is an improvement over the three-pole fused switch, as often only one fuse has blown, allowing the motor to operate single phase.

Since automatic circuit breakers have been used in connection with the slusher hoist motors, armature failures due to maintained high peaks and stalled scrapers have been largely eliminated.

Magnetic Concentration On the Mesabi Makes Progress

Butler Brothers plant at Cooley treats roasted jig tailings on wet cobbers successfully . . . To be remodeled and enlarged this spring

John J. Craig
Superintendent, Magnetic Roasting and Concentration Plant, Butler Brothers, Cooley, Minn.

THE MAGNETIC ROASTING and concentration plant of Butler Brothers is situated on the Mesabi iron range at Cooley, Minn. The plant was built in 1934 under a cooperative agreement between the University of Minnesota and Butler Brothers and was operated during the 1934 and 1935 seasons as an experimental unit under the direction of the staff of the Mines Experiment Station of the University. Then the interests of the University were sold to Butler Brothers, and the plant was put into semi-commercial operation in the spring of 1936. The season just closed marks the fourth year of operation.

Installation of this plant at Cooley made an ideal set-up, as it was possible to treat a material already mined and of approximately the desired size. If the cost of mining were to be added to the operating cost of this plant, the project would have been out of the question. The plant feed consists of —1¼-in. jig tailings, averaging 42 to 50 per cent iron, which have been rejected from the nearby Harrison and Patrick jigging and washing plants. The jig ore of the Cooley district tends to be slabby and porous, and this structure results in appreciable iron values being lost in jigging. Tailings consist principally of three materials: comparatively clean hematite, comparatively clean silica, and taconite, and various combinations of these three mechanically attached to one another. Further gravity concentration of these tailings has been tried, but has not been satisfactory; on the other hand, it has been found that magnetic roasting and concentration does produce a good recovery of a satisfactory grade of concentrate which is coarse enough in size so as not to require sintering.

Fig. 1 shows the plant as constructed in 1934. It consists of three major parts: (1) Preparation plant. The feed is put through a vertical shaft-type dryer in which the moisture of the feed is reduced from an initial content of from 8 to 10 per cent to a final content of approximately 3 per cent, by means of hot gases derived from the combustion of fuel oil. The ore is then crushed and screened before being charged to the furnace. (2) Roasting furnace. The roasting furnace is a vertical shaft-type furnace through which the ore travels continuously by gravity. The ore is heated in the upper part of the furnace by means of hot gases derived from the combustion of fuel oil; reduced from the hematite state to the magnetite state in the lower part of the furnace by means of oil vapor as a reducing agent; and quenched in water at the bottom of the furnace before being discharged. (3) Concentration plant. The artificial magnetite discharged from the roasting furnace is concentrated, wet, by means of magnetic concentrators, the two final products from the plant being the magnetite concentrate, which is shipped, and the fine tailing, which goes to the tailing pond, as is shown in the line cut on page 49.

Fig. 2 shows a condensed mechanical flowsheet of the plant. The jig tailings, approximately —1¼ in. in size, are dried to about 3.0 per cent moisture, crushed to approximately —¾ in. in a Symons crusher, and screened at 3 mesh, the two screen products being elevated separately to the furnace feed bins. The ore is converted from hematite (Fe_2O_3) to magnetite (Fe_3O_4) in the furnace[1]; the roasted product is discharged under water by means of a spiral scoop and pipe launder (No. 1), which discharges the product into pipe launder No. 2 at the end of which is a ⅜-in. punched plate trommel. Trommel oversize is elevated in a bucket elevator to a ⅜-in. wet vibrating screen at the top of the concentration plant; the trommel undersize, containing a large amount of water discharged from the furnace, goes to a sand pump, which elevates it, together with the ball-mill product, to a settling cone also at the top of the plant.

Oversize (—¾ in. + ⅜ in.) from the vibrating screen goes to the coarse magnetic cobber, which produces a magnetite concentrate and a middling; the undersize (—⅜ in. + ⅛ in.) goes to the intermediate magnetic cobber, which likewise produces a magnetite concentrate and a middling. The settling cone overflows a low-grade tailing product, which includes approximately 50 per cent of the water in the cone feed; cone underflow goes to a rake classifier, which also overflows a low-grade tailing. Cone and classifier overflows, together with a small amount of overflow from each of the magnetic cobbers, constitute the final plant tailing, which is pumped to the tailing pond.

The classifier rake product goes to

[1] For a complete description of this roasting furnace, see the following references: E. W. Davis: "First Magnetic Roasting Plant in the Lake Superior Region," A.I.M.E. Tech. Pub. 731 (1936). Also, E. W. Davis: "Magnetic Roasting of Iron Ore." Bull. 13, Mines Experiment Station, University of Minnesota (1937).

Fig. 1 . . . MAGNETIC ROASTING AND CONCENTRATION PLANT of Butler Brothers, at Cooley, Minn., on the Mesabi range. It consists of three major parts—namely, the preparation section, the roasting furnace, and the concentrator. The last is in the center of the picture

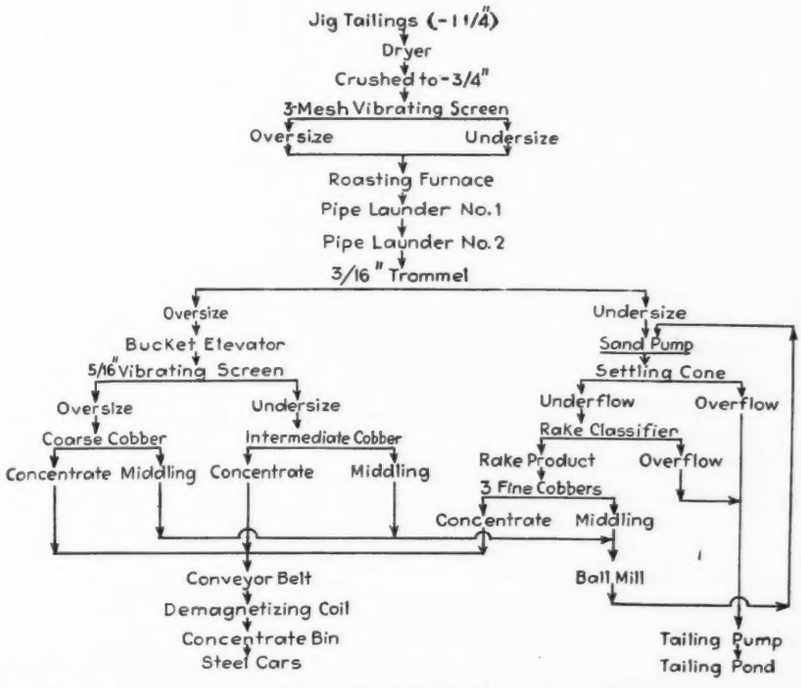


Fig. 2 . . . CONDENSED MECHANICAL FLOWSHEET of the plant at Cooley. Jig tailings are crushed, screened, roasted, and concentrated magnetically

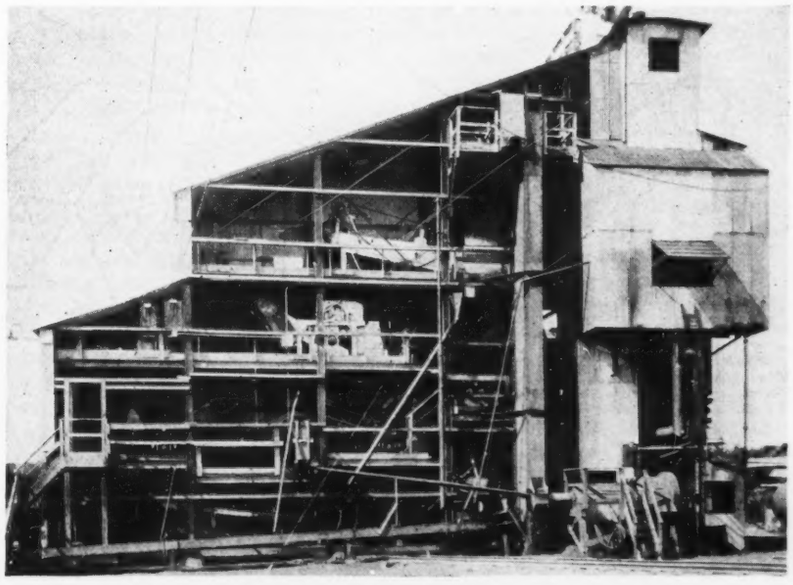


Fig. 3 . . . THE CONCENTRATION PLANT, as built in 1934 and essentially as it is today. A close-up view. Four magnetic cobbers are shown

two fine cobbers operating in parallel, each cobber producing a magnetite concentrate and a middling. These two middlings are further concentrated on a third fine cobber, also producing a final concentrate and a middling. This middling, together with the coarse and intermediate middlings, goes to a 5x4-ft. ball mill for further liberation of the iron oxide, the ball-mill product going to the sand pump and being elevated to the cone with the original trommel undersize. All of the cobber concentrates go to the concentrate conveyor belt, at the end of which is a demagnetizing coil, through which the concentrate falls freely into the concentrate bin. This demagnetized concentrate is shipped to the docks at the Upper Lake Ports, where it is mixed with other ores.

Fig. 3 shows a view of the concentration plant as constructed in 1934, and although several changes have been made since then in the auxiliary equipment and in the position of the cobbers, it indicates the general arrangement of the plant and furnishes a view of the magnetic cobbers, four of which are shown.

Fig. 4 presents a summarized normal metallurgical flowsheet of the entire plant, whereas Fig. 5 shows the summarized metallurgical flowsheet of the concentration plant only. Analyses and the per cent weights are on a dry basis. The screen analyses of the principal products are shown in the accompanying table.

Capacity of the plant is normally 265 tons of feed and approximately 175 tons of concentrate per 24-hour day. The plant feed rate is limited by the furnace capacity; the furnace feed rate normally varies from 10 to 11 tons per hour, depending on the structure of the ore and the distribution of the sizes in the furnace feed. This plant has produced 57,000 tons of concentrate, 24,000 tons of which was produced during the 1937 season.

The roasting efficiency of the furnace product is shown on the metallurgical flowsheet as 91.23 per cent, which means that 91.23 per cent of the iron in the furnace product has been converted to the magnetic state as indicated by a magnetic tube concentration test made at —100 mesh. Roasting efficiency depends not only on the furnace operating conditions but also on the structure and the composition of the furnace feed, with particular reference to the quantity of paint rock present, and on the distribution of the sizes in the feed. Inasmuch as iron silicates, such as are found in the

paint rock, are not reduced in the roasting furnace, the presence of this mineral in the feed decreases the recovery of concentrate produced.

The problem of classification in the plant differs from that in the normal gravity concentration plant because the middling material discharged from the ball-mill has already been magnetized while passing through the cobbers. In the first two years of the operation, a demagnetizing coil was placed ahead of the ball-mill so that the ball-mill feed would be demagnetized to obtain free settling of the particles in the classifier. At that time, the combined cone and classifier overflow was thickened and sent to an 18-ft. magnetic log washer for recovery of the fine iron values. It was then shown that equally good recovery could be obtained by omitting the demagnetizing coil and allowing the ball-mill product to go to the classifier in a magnetized state. It was apparent that the larger particles of magnetite acted as collectors for the fine-sized magnetite particles. As a result these fine particles of magnetite were discharged with the classifier rake product and recovered on the magnetic cobbers. Use of the magnetic log washer was then discontinued, as no further recovery of suitable concentrate could be made from the overflows.

Magnetic tube concentration tests made on the cone and classifier overflows after further grinding indicate additional recovery could be obtained by increasing the grinding capacity of the plant. The magnetic iron content of the total overflows, which is shown on the flowsheet to be 6.04 per cent, would be somewhat reduced with the finer grinding and concentration. Inasmuch as it has been desirable from a shipping standpoint to maintain the quantity of the —100 mesh material in the final concentrate at approximately 10 per cent or less, no effort has been made to date to increase the grinding capacity.

The five magnetic cobbers used are wet magnetic concentrators, construction of which is shown in Fig. 6. Each cobber consists of a cylindrical drum 31 in. in diameter and 32 in. long mounted in a tank equipped with a dewatering drag for removing the middling. The magnets inside the drum are stationary and have an effective width of 24 in. As the drum revolves, the pieces of magnetite oscillate on its surface, due to the alternating polarity of the magnets, and are removed from the drum by means of a take-off roller

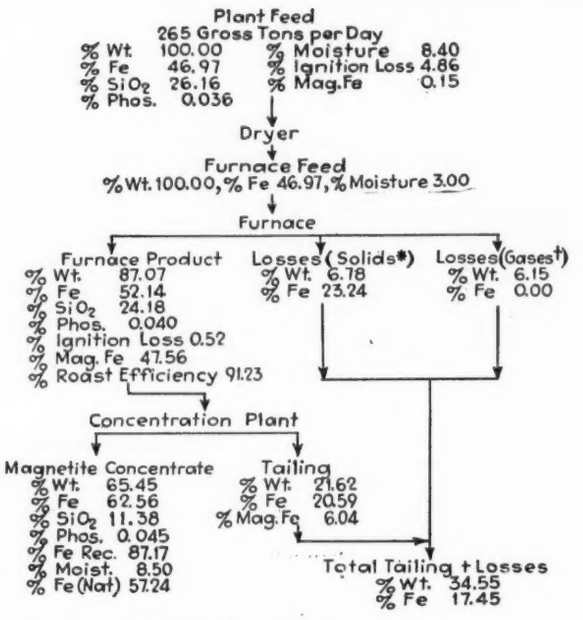


Fig. 4 . . . Metallurgical flowsheet, summarized, of the entire plant. Analyses and per cent weights are given on a dry basis

* Includes dust and slime losses
† Includes loss in weight of oxygen and water of crystallization

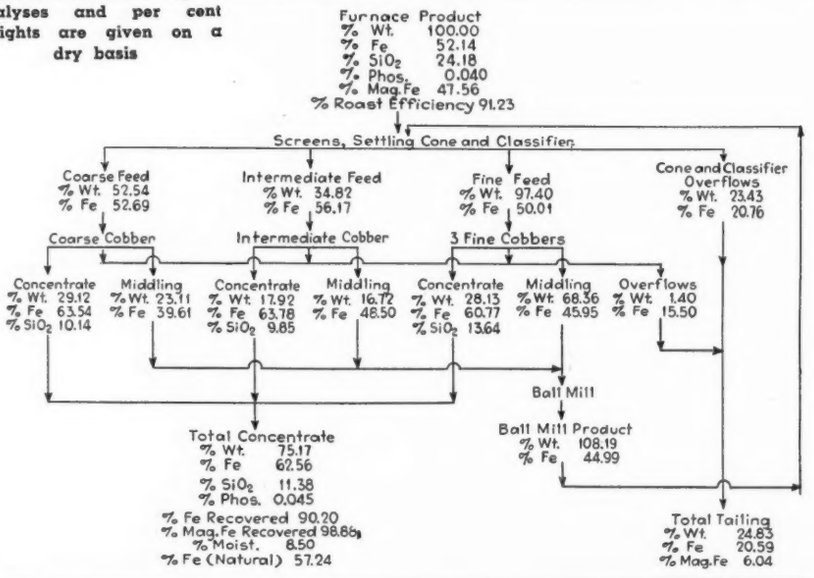


Fig. 5 . . . Summarized metallurgical flowsheet for the concentration plant only is shown here. As in Fig. 4, analyses and per cent weights are given on a dry basis

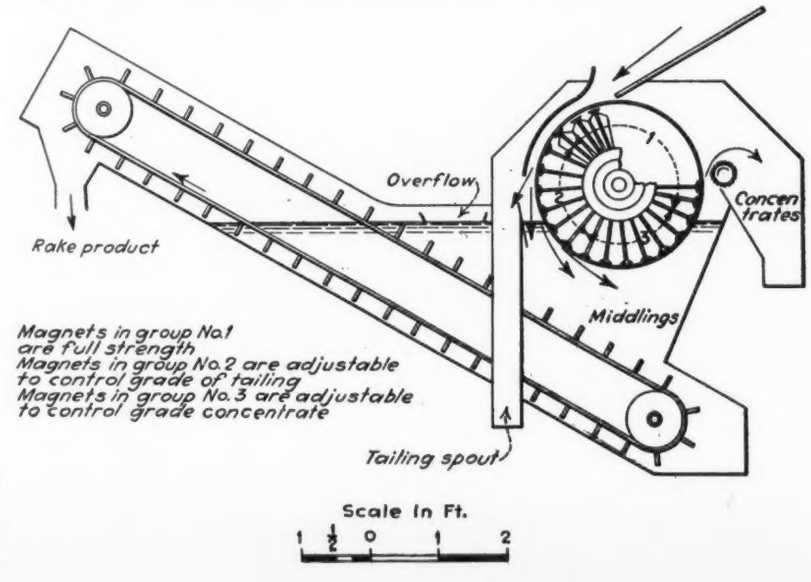

Overflow
Concentrates
Rake product
Middlings
Magnets in group No.1 are full strength
Magnets in group No.2 are adjustable to control grade of tailing
Magnets in group No.3 are adjustable to control grade concentrate
Tailing spout
Scale in Ft.
1 ½ 0 1 2

Fig. 6 . . . FIVE WET MAGNETIC COBBERS, such as this, are used in the concentration plant. In construction, each unit consists of a 31x32-in. drum mounted in a tank and equipped with a dewatering drag for removing the middling

made of mild steel and rotating at a relatively high speed. Movement of the drum through the water produces a washing action that tends to wash out fine pieces of non-magnetic material that may be trapped between pieces of magnetite and the drum surface. A small stream of fresh water entering the tank on the discharge side of the drum aids in the washing. The non-magnetic and the weakly magnetic materials constituting the middling fall to the bottom of the tank and are raked out by the dewatering drag. At present, only three of the cobbers are equipped with dewatering drags, and the other two are equipped with spigot discharges. The cobbers were originally made with a tailing spout to discharge low-grade tailing particles that would be discarded first from the drum. It was found, however, that, due to the structure of the ore, it was impossible to produce a low-grade tailing from these cobbers, and the tailing spout was eliminated. Three products are therefore made from each cobber: a concentrate, a middling, and an overflow which contains a small amount of low-grade solids.

At an earlier date, it had been felt that a thin film of magnetite on the outside of a piece of ore was all that was necessary to cause its retention in a magnetic field. In the experimental work conducted at the Mines Experiment Station previous to the erection of the plant, it was found that this was not true, but that the force of attraction, for a given field strength, depended on the ratio of the weight of magnetic iron in the piece to the total weight of the piece. This is an all-important factor, affecting not only the concentration of the roasted ore, but also the actual roasting of the ore, as it is obvious that, for best results, the furnace operating conditions, particularly the maximum size of ore particle and the time for reduction, must be such as to accomplish reduction of the entire piece and not just a "skin" roast. Examination has shown, however, that a number of the coarser pieces of concentrate may contain a small core or center of red hematite; these pieces appear to be high-grade concentrate, which means that the ratio of the weight of magnetic iron to the total weight of the piece is sufficiently high for the piece of concentrate to be recovered by the magnetic drum.

In the present plant flowsheet the two cobbers taking the coarse and intermediate feeds are working entirely on the original concentration plant feed, and the three fine cobbers, operating mainly in the regrinding circuit, also receive a small amount of undersize from the ⅜-in. trommel. Due to the necessity of keeping the total concentrate as coarse in size as possible, the ball-mill grinding is fairly coarse, with the result that the circulating load is normally equivalent in tonnage to that of the original plant feed. At times, when the roasting efficiency of the furnace falls off, due to difficulties in furnace operation or to adverse furnace feed, the circulating load increases to a point where the plant equipment becomes overloaded, and it is then necessary to bypass part of the fine cobber middling to the tailing belt, which discharges into tailing cars. It is only at these times that any coarse tailing is rejected from the plant.

From the flowsheets it may be seen that the weight recovery of concentrate is 75.17 per cent of the furnace product. This recovery depends not only on the iron content of the furnace product but also on the roast efficiency of the furnace product, the structure of the ore, and the grade of concentrate produced. The concentrate is shown to be 62.56 per cent iron and 11.38 per cent silica. The iron-silica ratio of the concentrate varies considerably from that of the concentrates produced in the washing and jigging plants, due to loss in weight of oxygen and combined water in the furnace operation. The phosphorus content of the total concentrate is 0.045 per cent, compared with 0.040 per cent in the furnace product and 0.036 per cent in the furnace feed; this increase is due to the fact that the phosphorus is associated more with the iron oxides than with the gangue minerals.

Iron recovery in the total concentrate is shown to be 90.20 per cent based on the furnace product, whereas the indicated magnetic iron recovery in the total concentrate is 98.88 per cent. This latter recovery of 98.88 per cent is the percentage that the total iron units in the concentrate bear to the magnetic iron units in the furnace product. The combined units of total iron in the concentrate and the units of magnetic iron in the plant tailing are greater than the units of magnetic iron in the original furnace product, because some non-magnetic iron is recovered in the cobber concentrate, resulting from an association of a small amount of non-magnetic iron with a relatively large amount of magnetic iron in some of the individual pieces; this condition occurs more in the larger pieces than in the smaller pieces. Tailing contains 6.04 per cent magnetic iron, or 3.15 per cent of the magnetic iron units in the furnace product. This leaves 96.85 per cent of the magnetic iron units in the furnace product as contained in the concentrate. The difference between the 98.88 per cent and the 96.85 per cent represents the additional percentage of units recovered in the form of non-magnetic iron.

The magnetite concentrate, which is in a magnetized state from the action of the magnetic cobblers, is demagnetized by passing the concentrate through a demagnetizing coil; this is a 220-volt alternating-current solenoid coil, with a 3½-in. Micarta tube in the center through which the ore falls. Inasmuch as the particles of the magnetized concentrate tend to adhere to each other and form a semi-mat, it is readily seen that demagnetization of the ore results in a shipping product that can be more easily mixed with other ores, and one from which the moisture will drain more freely.

Although the plant operating costs have been materially decreased during the past four years of operation, due to increased tonnage and to improvements made in the equipment and in its operation, the present operation of the plant as a whole is not economical, owing to the still relatively small daily tonnage handled. Changes are contemplated for the 1938 season which should result in a further reduction of operating costs. Expansion of the plant, contemplated for a near future date, is expected to put it on a commercial basis, assuming a low delivery cost of the feed to the plant. Moreover, the concentrate cannot stand any considerable amount of royalties or taxes and still leave the process as commercial.

Screen Analyses of Various Plant Products

Size		Furnace Feed		Furnace Product		Total Concentrate		Tailing	
		% Wt.	% Fe	% Wt.	% Fe	% Wt.	% Fe	% Wt.	% Fe
−1.050 in.	+0.742 in.	5.15	50.70	1.30	50.15	0.13	65.34	.....	.....
	+0.525 in.	12.12	49.85	11.58	53.18	5.54	65.92	.....	.....
	+0.371 in.	21.16	47.69	20.51	53.58	16.71	64.16	.....	.....
	+ 4 mesh	32.31	49.31	36.71	55.75	25.26	64.13	.....	.....
	+ 8 mesh	8.58	50.14	9.72	56.35	8.68	64.47	.....	.....
	+ 14 mesh	3.60	48.00	3.82	53.78	5.56	62.71	.....	.....
	+ 28 mesh	2.98	48.02	2.77	52.42	5.75	60.49	0.11	24.41
	+ 48 mesh	2.22	50.18	2.47	53.10	10.33	59.27	0.63	22.70
	+ 65 mesh	1.36	51.62	1.18	54.24	5.00	59.88	1.48	17.17
	+100 mesh	1.66	51.75	1.39	53.10	6.94	60.07	5.08	16.14
	−100 mesh	8.86	24.38	8.55	25.76	10.10	59.96	92.70	20.87
	Totals	100.00	46.97	100.00	52.14	100.00	62.56	100.00	20.59

Conveyor Transport in a Mesabi Underground Mine

(*Continued from page* 30)

rock bench, so that no stockpile trestle work is required when the electric locomotive and dump cars begin forming the stockpile from the edge of this bench.

During the summertime no need for stockpiling exists; consequently, current production is diverted to the field conveyor shown in Figs. 1 and 2 and in the accompanying photograph. This conveyor also receives the ore taken from the stockpile for washing by a 1½-cu.yd. shovel, which loads it into a traveling hopper. The hopper is mounted on rails and travels the entire length of the conveyor. It keeps the belt loaded to capacity by means of an apron feeder of adjustable speed. The field conveyor must be moved as each stockpile cut is completed. It is so arranged, moreover, that it also receives the current production, which it delivers, together with the ore taken from the stockpile, at any point in its setting onto a gathering conveyor. The latter in turn delivers the ore to a series of conveyors which elevate it out of the pit and deliver it in turn to the storage bin, the crushing and screening unit, and finally to the washing plant.

This system of transportation involves the use of a total of 4,440 ft. of 30-in. belt conveyor, of which 2,135 ft. is underground and 2,305 ft. either in the open pit or on surface. There are fifteen complete conveyor units involved, all of which are interlocked so as to shut down the entire system in case of accident to any individual unit. The system was designed to handle up to 400 long tons per hour of wash iron ore.

The installation has proved its efficiency in every way. It not only reduces the operating costs of transportation to a minimum but also insures against interruptions of production in every working place in the mine, inasmuch as chutes can be emptied continuously without having to wait for motors and cars used in the conventional way of mining.

All of the conveyors are of standard design and use 30-in. belts, so that all belts and idlers are interchangeable. Drives naturally cannot be interchanged, due to the varying horsepower requirements. All conveyor stands and galleries are of frame construction except that of field conveyor No. 9, which is made up of sectional steel stands, each section being mounted on skids to enable it to be changed in location from one shovel cut to the next.

The standard spacing of troughing idlers is 3 ft. 6 in. except at the loading point, where rubber-covered idlers are inserted at 2 ft. 6 in. spacing. The standard spacing of return idlers is 10 ft.

Wherever possible, especially on the larger units, gravity take-ups are used. All incline conveyors are equipped with automatic band-type brakes to prevent accidents in case of power failure.

A list of the LaRue mine conveying units is given in the accompanying table.

On the map in Fig. 1 will be found the length and speed of each conveyor belt of the underground system. Present working places on both the sublevel and the main level are shown. The tonnage produced per eight-hour shift is also indicated for each drift entering each working place, together with the height of the posts and the length of the caps in some cases. It will be noted from the map that the north side of the mine is practically exhausted.

On the map in Fig. 2 is shown in a heavy broken line the new conveyor belt system leading from the gathering conveyor No. 10 up the bank in unit No. 11 and on surface to the storage bin via units No. 12 and No. 13.

The old Shada washing plant, which is shown on the map, was used during the past season by the Clement K. Quinn Company, but at the time this map was made was under rental to Butler Brothers.

Conveyors in La Rue Mine

Unit No.	Location	Length, Ft.	Speed F.p.m.	Lift, Ft.	Location
1	U. G.(*a*)	750	220	34 (drop)	From west side working places to main drift
2	U. G.	225	275	18	Main drift extension of No. 1
3	U. G.	500	230	46	Main drift extension of No. 2
4	U. G.	160	200	2	Feeder conveyor from Old North workings
5	U. G.	500	340	26	Main drift extension of No. 3 into pit
6	O. P. (*b*)	260	370	61	From underground entry to surge bin conveyor
7	O. P.	150	375		No. 8 and stockpile pocket conveyor No. 7
8	O. P.	75	300	...	Stockpile pocket conveyor extension of No. 6 Transfer conveyor to surge bin; also extension of No. 6
9	O. P.	600	250	8	Field conveyor for stockpile loading and current production in summer
10	O. P.	150	300	10	Gathering conveyor for field conveyor No. 9
11	O. P.	375	350	118	Up bank of open pit, extension of No. 10
12	S (*c*)	275	300	31½	Crest of pit to transfer, extension of No. 11
13	S	190	350	30	Transfer to storage bin, extension of No. 12
14	S	80	...	...	From storage bin to screen and crusher (*d*)
15	S	150	...	....	Crushing plant to washing plant (*d*)

(*a*) U. G. = Underground. (*b*) O. P. = Open pit. (*c*) S = Surface. (*d*) Note that the last two units, Nos. 14 and 15, are actually part of the plant equipment.

"Velocity of Hit" In Rock Crushing

(*Continued from page* 46)

6. The 4.59-lb. steel shoe displayed a very pronounced break in all surface-velocity of hit curves at about 700 to 724 ft. per minute. In the range investigated there was no similar break found for heavier or lighter shoes. This sudden increase in the amount of new surface produced was due almost entirely to an increase in the amount of minus-400 mesh material. It seems possible that this peculiar behavior is due to a certain optimum relation among the variables—weight of shoe, velocity of hit, particle size of the feed, and size of charge. Before any explanation can be offered, it will be necessary to find out if similar effects can be noted with heavier and lighter shoes. Probably this will involve investigation of the crushing of larger and smaller sand grains, and larger and smaller charges.

7. It was found that increasing the weight of the shoe by simply resting a lead weight on the shoulder of the shoe was by no means equivalent to using a heavier solid steel shoe. A large part of the energy seems to go into deforming the lead, and the amount of additional crushing performed by the "lead" shoe is small when compared with the extra kinetic energy it possesses. The 6.25-lb. "lead" shoe, made by placing a lead weight on the 4.59-lb. steel shoe, showed the same "break" at 700 ft. per minute as did the original 4.59-lb. shoe. This break was not found when a 6.25-lb. steel shoe was used.

▼ ▼ ▼

A New Tripoli Plant In Tennessee

INITIAL SHIPMENTS of ground tripoli have been made by the McCall Mining Company, of Huntingdon, Tenn., from its new processing mill near Parsons, in Decatur County, Tenn. This production of tripoli, a heretofore unexploited resource of West Tennessee, marks the third prominent development in the mineral industry of that area in 1937.

The site of the McCall plant was selected because of extensive deposits available there under conditions favorable to mining. The tripoli, a soft yet coherent fine-grained white type, occurs in massive thick deposits.

The processing mill consists of a 4½x24-ft. rotary drying kiln, rotary screens of ¼-in. mesh, a 5 x 12-ft. tube mill, a "Raymond" mechanical separator, and accessory conveyors. All equipment is powered by a 60-hp. diesel engine, using fuel oil. The finished product can be classified to 99.75 per cent through 300 mesh. Mill capacity is rated at 1½ tons of ground tripoli per hour.

Limestone Mining In Muscoda No. 5

THE LIMESTONE PLANT stands at the mouth of Muscoda No. 5 ore slope. Two products are made, lump stone ranging from 2 to 7 in. in size and finer material ranging from 1¼ in. to 0.063 in.

E. M. Ball
General Superintendent

A. W. Beck
Chief Engineer

Tennessee Coal, Iron & Railroad Company
Subsidiary United States Steel Corporation
Birmingham, Alabama

UNDERGROUND CREW of Muscoda No. 5 limestone mine. These men won the Sentinels of Safety trophy for 1936 for the non-metallic group in the National Safety competition with a record of 114,701 accident-free man-hours

II. *Ventilation and other auxiliary operations are described The crew wins National Safety trophy*

▶ *DEVELOPMENT and mining practice at Muscoda No. 5 was dealt with by Messrs. Ball and Beck in the first part of this article, published in the December issue. The present concluding installment completes the picture of the work. The property is interesting on several counts, particularly because of the unique relationship of the limestone and the older iron-ore workings and the occurrence of methane*

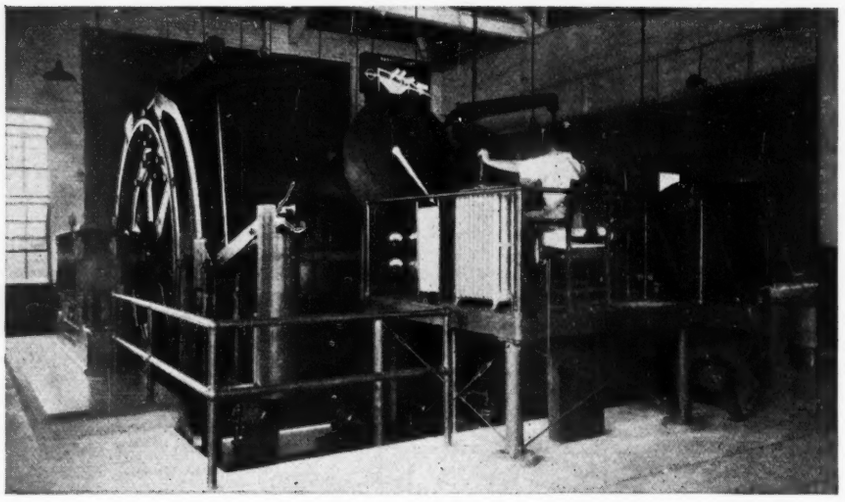
DURING the development of the limestone mine, ventilation was satisfactorily maintained by means of a booster fan of 50,000-c.f.m. capacity, installed on the ore slope near the foot of the material way to the mine. After the mine had been in operation four months, a large feeder of methane gas was unexpectedly encountered in the 2d Right Level. This feeder and a small one in the 4th Right Level were supplying approximately 250 cu.ft. of methane per minute, which, with the gas from the remaining workings, was sufficient to call for the provision of additional ventilation, for which facilities were promptly installed.

The limestone mine and two ore mines of the Muscoda division are ventilated by means of an 8 ft. by 3 ft. 6-in. double-inlet exhaust fan. This fan is on the surface near the portal of the limestone mine (Fig. 7), and is exhausting 125,000 c.f.m. of air against a 3.4-in. water gage. It is driven by a 125-hp., 2,300-volt, alternating-current motor through friction clutches and multiple V-belts. An auxiliary 80-hp. gasoline engine is used as a standby unit and is put in operation only in case of an electric-power interruption. The slowing down of the fan causes a blinker system to go out, at the same time sounding an automatic signal to warn the attendant. Twenty-five thousand cubic feet of air per minute is required to ventilate the limestone mine, the remainder being used for ventilating the two adjoining ore mines. The ventilating current for the limestone mine comes down the ore slope, up the material way to the limestone slope, and is split into two currents at this point to ventilate workings on either side of the mine. The two splits come together again in the airway to the ventilation raise, thence through an overcast on the ore slope into the return airway paralleling the ore slope. Blower fans discharging 2,800 c.f.m. of air through 12-in. flexible tubing are used in each mining level to maintain ventilation between the last crosscut and the face.

A certified gas inspector makes a complete examination of all working places in the mine before each shift goes on. This is necessary because feeders of methane gas seep into the mine through joint planes in the limestone bed.

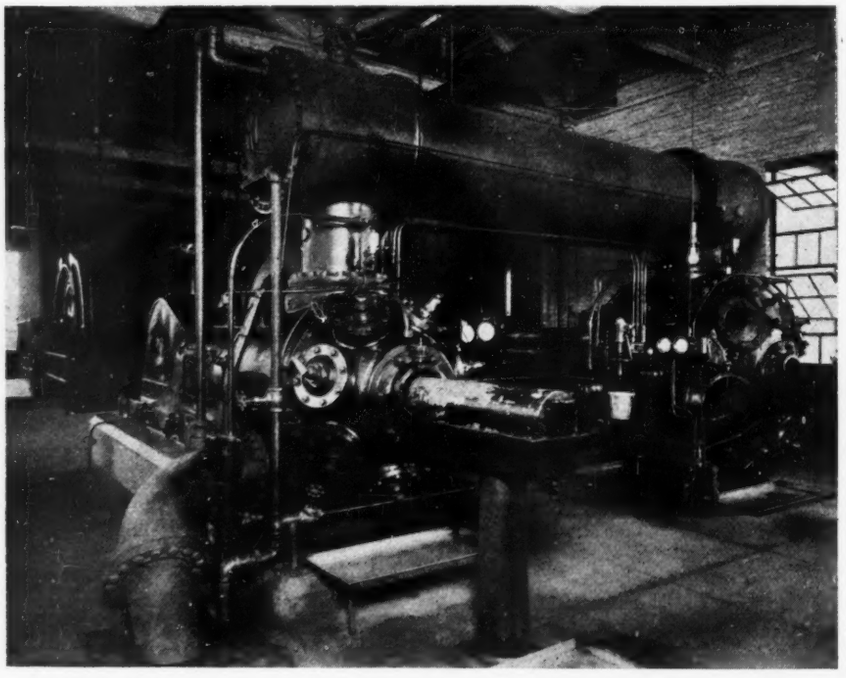
All compressed air for use in the limestone mine and the two ore mines of the Muscoda division is supplied from three electrically driven compressors situated on the surface (Fig. 8). One compressor at No. 5 engine house has a capacity of 5,250 cu.ft. of free air per minute. This compressor is equipped with a five-step automatic volume control, and delivers air through a 12-in. line into the limestone mine. The other two compressors, of 4,000-cu.ft. capacity, are at the No. 4 ore mine engine house. They are connected to the 12-in. air line by an 8-in. line.

The ore slope and limestone slope



THE SURFACE HOIST serving Muscoda No. 5 ore slope has a single 10 x 13-ft. drum and is driven by an 1800-hp. motor through single-reduction gears. It develops a hoisting speed of 2000 ft. per minute

FAN HOUSE and air duct near the portal of No. 5 ore slope. The fan is an 8x3½-ft. double-inlet exhaust unit of 125,000 c.f.m. capacity and is driven by a 125-hp. motor



THIS AIR COMPRESSOR, of 5250 cu. ft. capacity, is equipped with five-step automatic volume control and delivers air into the limestone line through a 12-in. line

are illuminated with 200-watt, 220-volt, alternating-current lamps, suspended from brackets placed at intervals of 100 ft. A floodlight at the top of the man-and-material way furnishes its illumination. In the mining levels, electric lights are connected to the 250-volt, direct-current mechanical-loader circuit.

Mine-type telephones are located in each mining level and are connected to vital points both on surface and underground. When hoisting or lowering men, the skip tender communicates by telephone with the hoisting engineer before the regular hoisting or lowering signals are given.

The single-track surface tipple is of steel construction and has a flat-bottomed pocket of 125 tons' capacity. This pocket is lined with rails to take up the shock of the stone falling when the skip dumps. The material falling into the pocket forms its own hopper. Stone is fed from the pocket by a chain feeder, into a 40x48-in. all-steel primary jaw crusher set to produce a 7-in. product (Fig. 10). The product from the primary crusher is discharged to a 36-in. inclined belt conveyor. A chain drag decreases the impact of the stone as it falls on the conveyor belt. A magnetic head pulley 30 in. in diameter removes tramp iron before the conveyor discharges to a 4 ft. by 8 ft. 6-in. vibrating scalping screen, which has 2-in. square openings.

Stone which passes over the scalping screen is discharged by chute directly into railroad cars on a siding, ready for shipment to the company's open-hearth plant. The flow of stone in the chute is controlled by an air-operated gate, allowing the spotting of cars without delay to the plant. Undersize stone from the scalping screen goes by gravity to a 5½-ft. cone crusher set at 1¼-in. opening. The product from this crusher is delivered by chute to a 24-in. inclined belt conveyor, which leads to the top of the washing plant. This conveyor discharges to a 4 ft. by 8 ft. 6-in. double-deck vibrating and washing screen with 1¼-in. and ¾-in. openings, respectively, on the top and bottom deck. The three sizes of stone produced are next fed to a similar screen with ¼-in. and 0.063-in. openings. Pressure water sprays are used on both screens, thoroughly washing the stone and removing the fines. Stone from the two screens is discharged into railroad cars for shipment to the company's lime-burning plant. A flap gate controls the flow of stone through two chutes, so that loaded and empty cars can be handled without delay to the plant.

The fine material passing through the screen is discharged into a conical steel sump tank with all wash water. A 4-in. sand pump handles it from here to a 90,000-gal. conical steel

settling tank 500 ft. distant. The tailings from this tank flow into a waste pond. The elevation of the tank allows the clear water overflow to return by gravity to the washing system. Washer plant and car drippage is collected on a concrete drip pad and is automatically pumped back into the settling tank and water recovery system.

The plant is of steel construction throughout. Crusher foundations are of concrete. The inclosed parts of the plant have copper-bearing, corrugated metal siding and roofing.

An automatic-sequence starting and stopping system is used for all plant motors, which are controlled from a main switchboard in the control room. Local pushbutton switches also are used. Should a motor overheat, it actuates a thermal relay and stops all plant machinery in sequence.

The main surface hoist has a single drum keyed to the shaft, the drum being 10 ft. in diameter with a 13-ft. face. It is driven by an 1,800-hp., 60-cycle, 2,300-volt, alternating-current motor, operating at 360 r.p.m.

Table III—Miscellaneous Operating Statistics First Eight Months of 1937

Average number of men per shift	75
Per cent of white employees	80
Per cent of colored employees	20
Tons of stone per man per eight-hour shift (producing labor)	21.2
Tons of stone per man per eight-hour shift (entire mine crew)	8.2
Tons of stone per pound of explosive	1.2
Kilowatt-hours per ton of stone mined for:	
Scraper operations	0.825
Main surface hoist	4.180
Limestone slope hoist	0.740
Crushing, screening and washing	1.380
Pumping	1.210
Ventilation	3.050

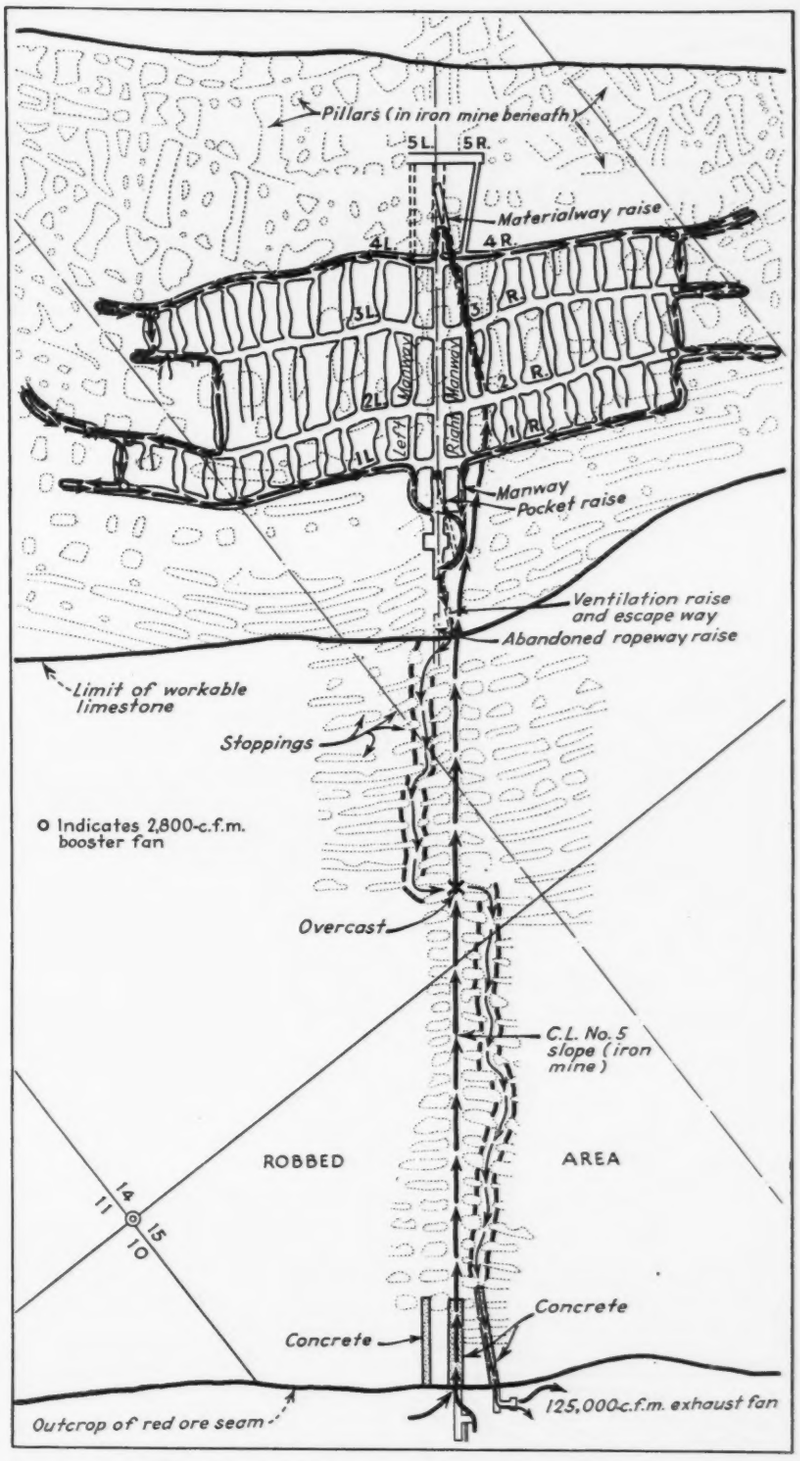


Fig. 7 . . . VENTILATION of the limestone mine, Muscoda No. 5, is accomplished with a 125,000-c.f.m. exhaust fan, 20 per cent of this capacity being required for the limestone workings and the remainder for two adjoining ore mines. Blower fans and flexible tubing also are used on each mining level

through single-reduction gears to develop a hoisting speed of 2,000 ft. per minute. The hoist is equipped with magnetic-control, dynamic braking system, hydraulic-control post brakes, Lilly hoist controller, track limit switches, and visible skip-position indicator. A miniature tipple placed over the indicating dial is wired to insulated sections of the track in the main tipple. When the skip passes over these sections, it completes the electrical circuit and a light shows on the miniature the exact position of the skip while dumping. The hoist is located to one side and at right angles to the slope center line. The hoisting rope is of 6x21 $1\frac{3}{8}$ in. lang-lay construction. It runs from the hoist to a 10-ft. diameter turn sheave at ground level, and thence to a 10-ft. diameter head sheave at the top of the surface tipple.

Power for the operation of the surface hoist, compressors, crushers, and all underground electrical equipment is furnished from a central power house at the Fairfield steel works blast furnaces. It is delivered at 44,000 volts to a 5,000-kva. transformer substation near No. 5 engine house, where the voltage is stepped down to 2,300. Power at this voltage is transmitted into the mine through 600,000-circular mil, three-conductor, armored cable, to the motor-generator station in the ore slope below the limestone mine. This station is equipped with a 300-kva. motor-generator set with automatic controls. Direct current at 250 volts for mechanical loading is supplied

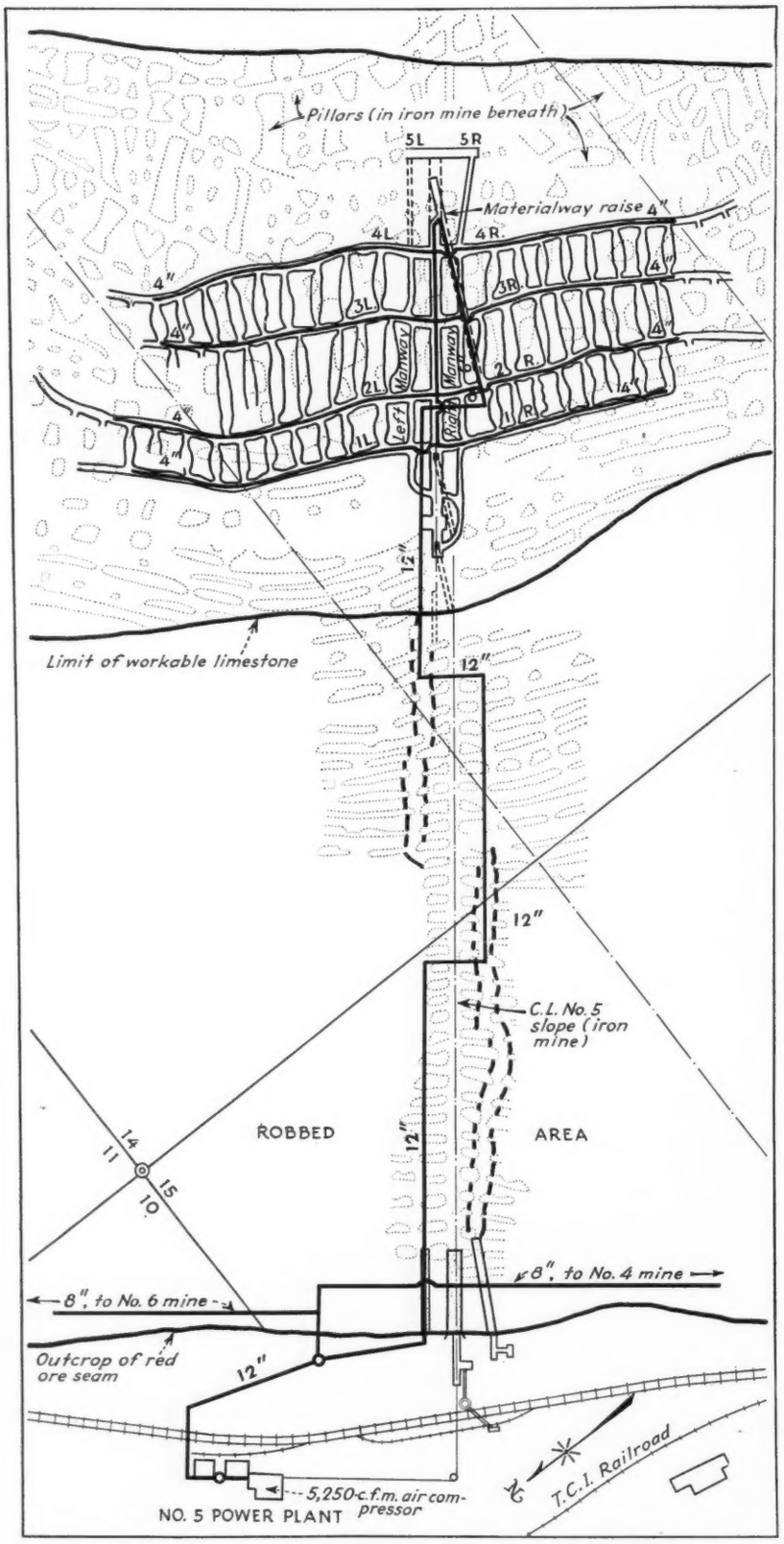


Fig. 8 . . . COMPRESSED AIR for the limestone mine as well as for the two adjoining iron ore mines is supplied from three electrically driven compressors situated on the surface. One of these, of 5,250-cu. ft. capacity, delivers air through a 12-in. line into the limestone workings. The other two are connected to this line by an 8-in. line

through a 1,000,000-circular mil feeder cable. Alternating current at 2,300 volts is supplied for the double-drum limestone slope hoist through a 2/0 cable which is connected to the main 600,000-circular mil cable. Alternating current for the man-and-material hoist is supplied through a No. 6 cable, connected to the main cable.

Cost per ton of stone mined, crushed, washed, and delivered into railroad cars ready for shipment to the Ensley and Fairfield steel works consists approximately of 70 per cent for labor and 30 per cent for supplies and power. Table III gives a few statistics, averaged for the first eight months of 1937.

All men underground and the surface hoisting and assistant hoisting engineer, crusher men, helpers, and timekeeper are paid on an incentive system of pay, with a guaranteed occupational wage as a base. The producing crew in each mining level is a seven-man crew, consisting of head miner, two drill runners, one scraper-hoist operator, and three section helpers. The day shift only is worked, and an eight-hour turn at the working face is in effect. A standard number of tons per man-hour was established for the producing crews in the mining levels. When the tons per man-hour, loaded by a crew during a pay period, exceeds this standard, the payment of bonus begins. The bonus is distributed to every man in that mining crew on the basis of an equal per cent increase over his basic occupational rate. The amount of bonus is governed by the increase in tonnage over the standard. Head miners and drill runners are paid an additional bonus, which is based on the tons of stone broken per pound of explosive in excess of a predetermined standard.

The incentive earnings of the producing crews differ in each mining level. At the close of each pay period, an average is computed for the entire mine. Service or maintenance men are given a percentage increase over their basic occupational rate, based on this average.

The mine superintendent gives a talk to each new man employed, safety being emphasized. The new employee is then placed in a crew under a foreman thoroughly experienced in handling new men, and given special supervision and instructions. Every crew foreman throughout the mine is responsible for the safety of his men. He gives daily instructions on safety and on all phases of the work. The mine foreman and his assistant examine daily all working places to insure safe conditions and practices. The mine inspector and his assistant make complete inspections at regular intervals, reporting to the management exact conditions found at time of inspection.

Workmen reported for unsafe practices or violations of safety rules are disciplined by the superintendent, either through reprimand, temporary suspension from work, or discharge. Monthly meetings are held by the superintendent. All foremen, subforemen, and head miners attend. Any accidents that have occurred are

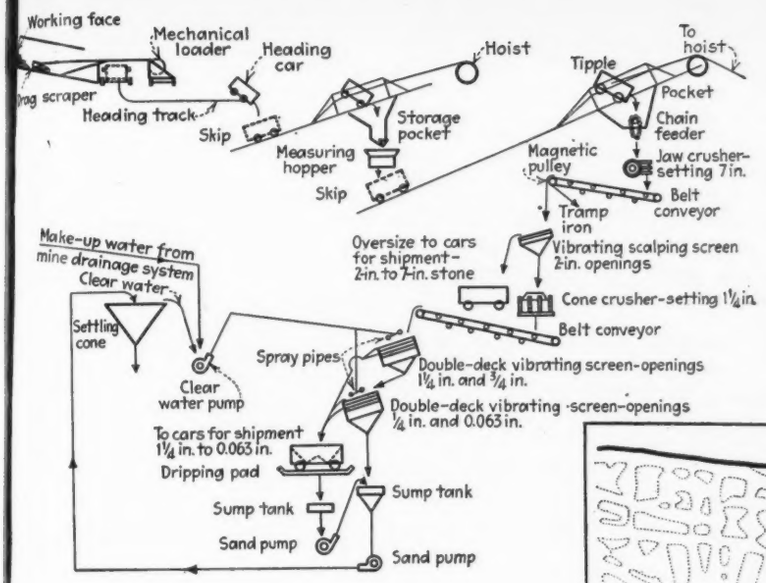


Fig. 10 . . . LIMESTONE HANDLING and preparation for shipment to the furnaces is shown here, beginning with the point of loading in the stope. The preparation plant is built of steel throughout

Fig. 9 . . . ELECTRIC POWER is distributed through the limestone workings from a 5,000-kva. substation, near the slope mouth, where it is stepped down to 2,300 volts from the 44,000 volts at which it is generated at the Fairfield steel plant. A motor-generator set in the ore slope below the limestone workings provides direct current for scraper use

thoroughly discussed, and suggestions are made for improvements in operation and future prevention of accidents. A program of first-aid training is followed, classes being held in the mine office. Those selected for training are paid for their attendance.

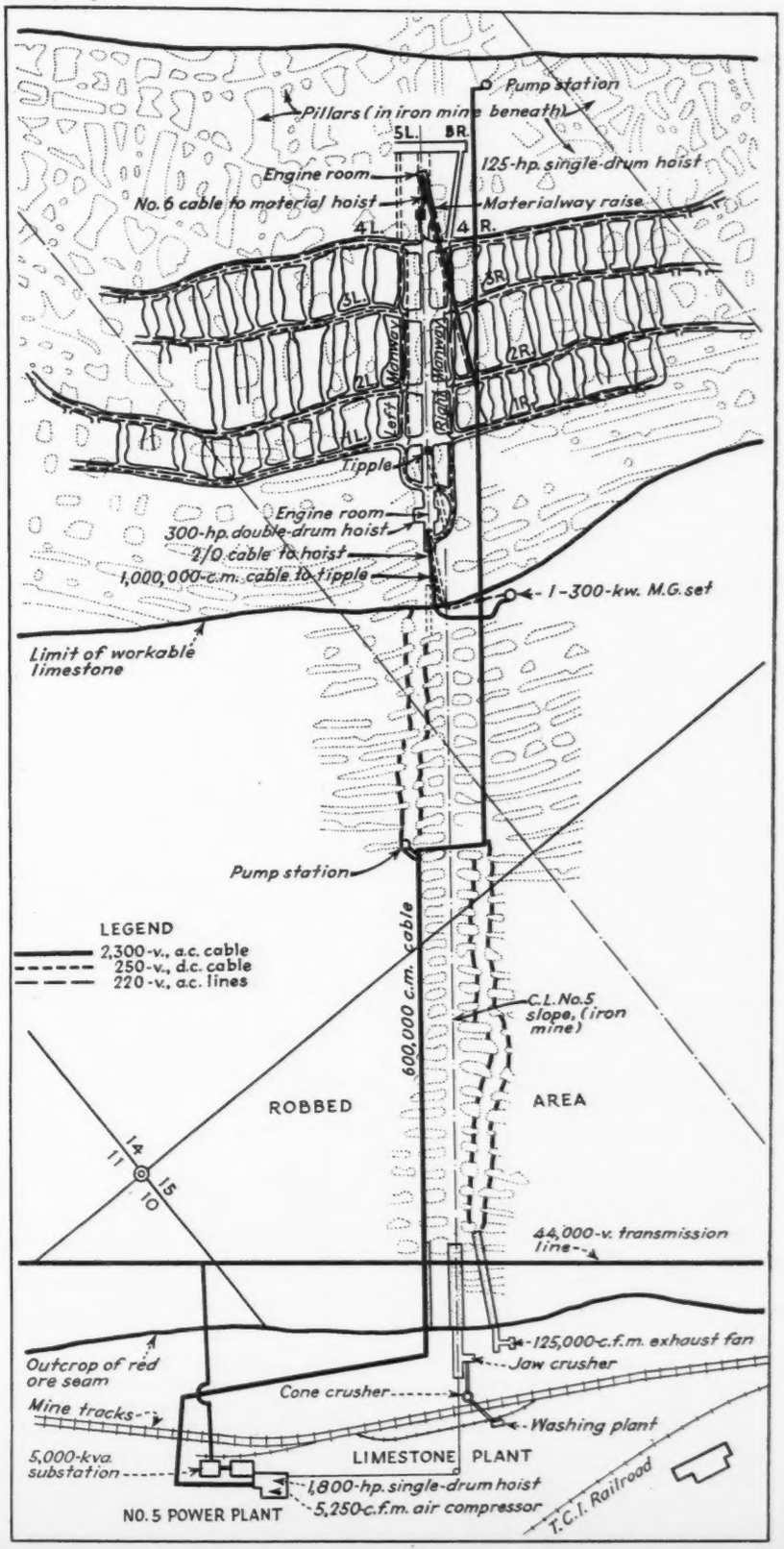
In its first year as a participant in the National Safety competition, the No. 5 limestone mine won for the year 1936 the Sentinels of Safety Trophy for the non-metallic group. First place was won with 114,701 accident-free man-hours. On Oct. 21, 1937, there had actually elapsed a period of 928 days since the last occurrence of a lost-time accident.

Use of the services of the local company physician or of the employees' hospital is optional with the employee. Physicians are on call 24 hours each day, and employees desiring their service pay a small monthly fee. This entitles the men and their families to dispensary service and hospitalization at the employees' hospital at a reduced cost. Employees living more than 2½ miles from a company dispensary are required to pay for each visit of the doctor.

In the event of an accident in or around the mine, the injured party receives first aid by fellow workmen and is then sent to the local dispensary for emergency treatment. When accidents are of a serious nature, the patient is immediately taken by the company ambulance to the employees' hospital at Fairfield.

It was found that, in order to keep the stone of a more uniform analysis and low silica content and to meet more stringent specifications, it was necessary to reduce the height of stone mined from 40 ft. to 28 to 30 ft. This was essential because of chert inclusions in the upper and lower portions of the limestone bed.

Mining operations have been conducted since May 13, 1931, the only serious interruption being the time required for the installation of a new ventilation system.



NEW BOOKS

DIE METALLISCHEN ROHSTOFFE. Ihre Lagerungsverhältnisse und ihre wirtschaftliche Bedeutung. Vol. 1. Vanadium, Uranium, Radium. *By Geh. Rat Prof. Dr. Paul Krusch. Published by Ferdinand Enke Verlag, Stuttgart, 1937. Pp. 148; 17 illustrations. Price:* Rm *10.00 (less 25 per cent in foreign countries).*

WRITTEN by the well-known economic geologist and head of the Geological Institute of Prussia, this pamphlet may be called the first installment of a new treatise on the metallic ore deposits of the world. It is a direct result of the economic rehabilitation plan recently instituted by the German Government. Dr. Krusch explains that the study of ore deposits has been greatly neglected by German geologists since the World War. Pointing to the recent rapid development of this particular field of geology in Great Britain and the United States, he holds that a thorough review of the world's ore deposits and the pertaining literature is essential for the success of Germany's four-year plan. Fifteen pamphlets are scheduled for publication during this period, covering so-called "metallic raw materials" in the order of their importance for the economic development of Germany.

Vanadium, uranium, and radium are apparently the most desirable of metals from the viewpoint of the Germans, for their discussion constitutes pamphlet number one of the series. A short historical résumé of the discovery of vanadium is followed by a chapter on the composition, occurrence, and formation of vanadium ores. The particular ore localities are then discussed in detail, arranged according to their geographical distribution, by continents. North America, South America, Africa, Australia, Asia, and Europe follow in the order named. If the known and suspected vanadium deposits of Germany are treated with an emphasis somewhat out of proportion to their world-wide importance, such discrepancy can be excused in view of the stated purpose of this publication. Methods of refining the ore and the various commercial applications are also included. Finally, information on market conditions, world production, ore reserves, and current prices complete this up-to-date account of the metal. Uranium and radium are presented jointly in a similar manner.

The very thoroughness of treatment is the most valuable asset of this work. Long lists of detailed references from the world-literature on the subject are given at appropriate intervals and constitute one of the principal advantages of the paper.

Seventeen geological maps and cross-sections appear in the text but are of questionable worth, due to poor reproduction or excessive reduction of the originals.

In keeping with the factual presentation, style and language are direct and simple. When completed, this work should prove a welcome addition to the reference shelf of economic geology.

KURT E. LOWENSTEIN

MODERN WEIGHTS AND MEASURES. *By Walter Renton Ingalls, B.S., D. Eng., president of the American Institute of Weights and Measures. Published by the American Institute of Weights and Measures. 33 Rector St., New York City; 1937. Pp. 75. Price $1.*

DR. INGALLS continues to oppose in this book the compulsory substitution of the metric system for the English and American systems of weights and measures—a position he has long maintained. The volume is a fair and keen analysis of both points of view on this contentious subject. It contains a brief historical summary and in its ten supplementary chapters an array of facts and data that provide a logical basis of comparison as to the utility and practicability of the respective systems to the business, trade, and commerce of the nations of the world. This thin but meaty work deserves a niche in the libraries of business executives and engineers who need quickly obtained and authoritative information on weights and measures.

INDUSTRIAL MINERALS AND ROCKS (Nonmetallics Other Than Fuels). *Edited by the Committee on the Industrial Minerals Volume, Samuel H. Dolbear, Chairman, Oliver Bowles, Vice-Chairman. Published by the American Institute of Mining and Metallurgical Engineers, New York. Pp. 955. Price $6 net. ($2.50 for the first copy to members of the Institute, including student associations).*

THIS NEW VOLUME, sponsored by the Seeley W. Mudd Memorial Fund, is indeed a monumental contribution to the literature of nonmetallics. Not so many years ago, information on all save a few of the minerals in this category was scanty, aside from such questions as those of geographical distribution, geologic occurrence, and production figures, and even on these it was imperfect. The important matters of mining and preparation for market were sadly neglected, this reflecting the existing backward technology (save for the aforesaid major nonmetallics) that spelled low recovery and a grading for market that was generally poor and unreliable. The appearance of "Marketing of Metals and Minerals" in 1925 (previously published as a series of articles in *Engineering and Mining Journal*) represented a well-organized effort to collect and disseminate useful information along these neglected lines, with reference to their bearing on marketing, particularly where nonmetallics were dealt with. This was followed in the same year by Ladoo's "Non-Metallic Minerals" which treated the subject of preparation more specifically and in more detail. Both of these books sought, in part, to capitalize the fact that the nonmetallic field was rich in opportunity for the technically trained man, a fact previously stressed by the Bureau of Mines. But, just as Rome was not built all at once, these books left much undone. Since their appearance, moreover, ten years have rolled by, with the need for a comprehensive treatise on nonmetallics and their preparation for market steadily mounting. The new book "Industrial Minerals and Rocks" has met this need in a magnificent, masterful way. It has been well conceived and planned, thanks to Mr. Dolbear and Dr. Bowles and to their able committee and its advisers. The 48 chapters, each by a specialist and dealing with a single mineral or a group of related minerals, avoid overlapping one another and give collectively the comprehensiveness desired. The book is in fact a compact library on the nonmetallics, and a surprisingly interesting one.

MARKET CONTROL IN THE ALUMINUM INDUSTRY. *By Donald H. Wallace, Harvard University Press, Cambridge, Mass. Pp. 599. Price $5.*

ONE OF THE SERIES of "recent Harvard economic studies," this volume is somewhat amazing in size until one reads that its purpose is to explain "the continued existence of single-firm monopoly of the basic product in the United States and of strong monopolistic elements abroad," and also to evaluate the consequences and assess the relative merits of alternative mixtures of competitive and monopolistic elements, and to explain some of the problems created by the existence in some fabricating stages of independent competitors with the firm or firms from which they get their raw materials.

Part I deals with historical development; Part II with the nature of market control and the basic product; Part III with some consequences of various kinds of market control; Part IV with relations between monopoly of the basic product and independent competitors at later stages—also some aspects of American experience. A large amount of material has been brought together.

Complaint is made that the failure to obtain adequate information upon certain points has been a stumbling block; likewise the limitations of economic method in analyzing the results of mixtures of competitive and monopolistic forces.

The author, who is assistant professor of economics at Harvard, advocates no plan for economic reform in the aluminum industry, saying that more adequate information is necessary to deter-

mine whether some sort of change is worth while. He does, however, in concluding, suggest the production of ingot and possibly of some fabricated products by the Government as the only way of attaining a maximum of desirable results, unless executives know how to promote public welfare and place it ahead of private advantage when the two conflict.

RHYMES OF THE MINER. *By E. L. Chicanot. Federal Publications Limited, Gardenvale, Que. Pp. 195. Price $3.*

THIS is an anthology of Canadian mining verse compiled and edited by Mr. Chicanot at the direction of the *Canadian Mining Journal* in an effort to preserve the pioneer poetry of the Dominion so far as it relates to mining. Many of the poems convey the flavor and romance of mining which one often feels but is usually unable to express, unless he happens to be gifted. The book, moreover, is unusual and will round out one's mining library. Much of it is entertaining, if only for casual reading.

SEGMENTAL FUNCTIONS, TEXT AND TABLES. *By C. K. Smoley. Braunworth & Company, New York. Pp. 440. Price $5.*

AIMING TO FACILITATE calculations for engineers whose work involves problems dealing with parts of a circular segment such as the arc, chord, radius, the central angle sustended by the arc, and the abscissa, this pocket size book covers a long felt need. The author is well known in the engineering world and his other book, Parallel Tables of Slopes and Rises, is used by many mining and metallurgical engineers in connection with mine and mill plant design. Part I of the book deals with the new mathematical entity called Segmental Function. Logarithms of these segmental functions worked out by the author simplify and shorten the solution of circular segment problems by means of additions and subtractions. Part II contains reprints from Smoley's Parallel Tables of Logarithms and Squares, also extension of logarithms of the English system of linear measure to 200 ft. The author devotes ample space to type problems, which are easily followed. Engineers will find this book a time saver that assures accuracy in calculation of parts of circular segments.

H. C. C.

FINANCIAL POST SURVEY OF MINES, CANADA, AND NEWFOUNDLAND, 1937-38. *MacLean Publishing Company, Ltd., Montreal, Canada. Pp. 284; 9x12 in. Maps 21. Price $2.*

IN THIS twelfth annual mining directory, 2,100 mining companies are analyzed with respect to location, development, management and financial status. One of the new features is a special section of maps of all important Canadian mineral areas. The volume also contains the price range of Canadian mining stocks, statistical tables of Canadian mineral production, dividend records, prices of metals, and a list of the principal mining and milling plants with names and addresses of operating officials.

PUBLICATIONS

RECEIVED

✦ *Motion Picture Films of the Bureau of Mines.* A 26-page booklet published by the U. S. Bureau of Mines, Washington, D. C.

✦ *Imports into the United States for Consumption, by Countries, for the Calendar Year 1936.* United States Tariff Commission, Washington, D. C. Vol. 3, of a series of four volumes, dealing with imports of metals and ores.

✦ *Annual Report of the Smithsonian Institution, 1936.* For sale by the Superintendent of Documents, Washington, D. C. Price $1.50 (cloth cover). Pp. 446.

✦ *Index* to Vols. XI to XXXVIII (1908-1935) of Transactions of the Canadian Institute of Mining and Metallurgy and of the Mining Society of Nova Scotia. Pp. 229. Price, half-leather, $7.50; cloth, $6.50.

✦ *California Directory of Mineral Producers* and statistics on mineral production, 1935. By H. B. Symons. California Division of Mines, San Francisco. Pp. 205.

✦ *Mineral Resources of Plumas County.* California "Journal of Mines and Geology." Pp. 79-171 inclusive.

✦ *Virginia Geology, Contributions to.* Includes thirteen papers. Bulletin 46. Virginia Geological Survey. University, Va. Pp. 211.

✦ *Geophysical Studies.* A list of publications issued in 1932-1936 by the department of geophysics, Colorado School of Mines, Golden, Colo. Each paper is abstracted in English and in German.

✦ *American Geophysical Union Transactions.* Annual meeting, April 28, 29, 30, 1937, at Washington, D. C., and regional meeting at Denver, June 21-26, 1937. Part I. Pp. 264.

✦ *Bibliography on Mines and Mining in the Philippines.* By Cirilo B. Perez and L. Estrella-Villanueva. Bureau of Science, Manila, P. I. Pp. 100. Price 50c.

✦ *Air Hygiene Foundation of America, Inc., Pittsburgh, Pa.* Complete reports of committees on physiological effects of dusty atmospheres in industry, presented at a special meeting of members, Nov. 30, 1937. Available on request without cost.

✦ *Investigations in Ore Dressing and Metallurgy, July to December, 1936.* (Testing and Research Laboratories). Bulletin No. 776. Bureau of Mines, Ottawa, Ont. Pp. 204.

✦ *El Oro en el Perú en* 1936. By Jorge Hohagen. Bulletin of the Cuerpo de Ingenieros de Minas del Peru. Pp. 156.

✦ *Chromite Deposits of the Bushveld Igneous Complex, Transvaal.* By W. Kupferbürger and B. Wasserstein. Geological Series Bulletin No. 10, Geological Survey, Union of South Africa, Pretoria. Pp. 48 and maps. Price 6d.

✦ *Gold Coast Colony.* Report of the Geological Survey Department, 1936-37. Government Printing Department, Accra. Price, 2s.

✦ *Miscellaneous Nonmetallic Minerals in Canada, 1931.* Dominion Bureau of Statistics, Ottawa. Pp. 29. Price 15c.

✦ *The Mica Industry in Canada, 1936.* Dominion Bureau of Statistics, Ottawa, Ont. Pp. 16. Price, 10c.

✦ *Pyrophyllite Deposits of Manuels, Conception Bay.* By John S. Vhay. Bulletin 7. Geological Survey of Newfoundland, St. Johns. Pp. 32 and 2 maps.

✦ *Barite.* By George I. Whitlatch. Markets Circular No. 7. Division of Geology, Department of Conservation, Nashville, Tenn. Pp. 25.

✦ *Asbestos.* By G. E. Howling. Second edition of a group of publications on minerals issued by the Imperial Institute, South Kensington, London, covering world resources, dressing and grading, uses, marketing, and trade statistics. Pp. 88. Price, 2s. net; postage 3d.

The United States Bureau of Mines, Washington, D. C., has issued the following information circulars:

✦ *Mining and Grinding Methods and Costs at the Malvern Clay Company Mine, Malvern, Ohio.* By E. J. Lintner. Pp. 22. I.C. 6962.

✦ *Annual Report of the Nonmetals Division, 1937.* By O. C. Ralston. Pp. 18. I.C. 6974.

✦ *Placer Operations of Humphreys Gold Corporation, Clear Creek, Colo.* By E. D. Gardner and J. R. Guiteras. Pp. 16. I.C. 6961.

✦ *Mining Methods and Costs of the Quartz Hill Mining Company, Dewey, Mont.* Pp. 17. I.C. 6963.

✦ *Earth Vibrations Caused by Quarry Blasting.* Progress Report No. 1. By J. R. Thoenen and S. L. Windes. Pp. 73. R. I. 3353.

✦ *Occurrence and Treatment of Mercury Ore at Small Mines.* By M. W. von Bernewitz. I.C. 6966.

✦ *Pebble-phosphate Mine Accident Experience.* By F. E. Cash and C. P. Dempsey. Pp. 12. I.C. 6968.

✦ *Methods and Costs of Mining and Crushing Gypsum at the Mine of the Ebsary Gypsum Company, Inc., Wheatland, N. Y.* By E. J. Lintner. Pp. 19. I. C. 6971.

✦ *Mining Methods and Costs at the Mount Isa Mines, Ltd., Mount Isa, Queensland, Australia.* By J. Kruttschnitt and V. I. Mann. Pp. 35. I. C. 6978.

✦ *Sampling and Testing of a Gold-Scheelite Placer Deposit in the Mojave Desert, Kern and San Bernardino Counties, Calif.* By H. W. C. Prommel. Information Circular 6960, U. S. Bureau of Mines, Washington, D. C.

✦ *Mining and Reduction Methods and Costs at the Oceanic Quicksilver Mine, Cambria, San Luis Obispo County, Calif.* By A. W. Frolli. Information Circular 6950, U. S. Bureau of Mines, Washington, D. C.

Summary of the

MARKETS

CONSUMPTION of non-ferrous metals in this country registered virtually no improvement in December, and purchases again were held down to a minimum. The trend of prices was downward, the *E.&M.J.* index for the month falling to 75.18, which compares with 78.91 in November. For the year, however, the index number was 90.86, against 73.45 for 1936. The operating rate of the steel industry ended the year at 19.2 per cent of capacity.

Domestic copper sold down to 10c., Valley basis, early in the month. Inquiry for copper at that figure was sufficient to bring about a steadier tone, but the price moved up only moderately as buying improved, ending the year at 10⅛c. Domestic sales for December came to 26,504 tons, against 21,035 tons in November. Production was curtailed further during December, but, with deliveries at a subnormal rate, another increase in domestic stocks undoubtedly occurred. Foreign demand was good, with Russia, Italy, and Japan steady buyers. The foreign price was unsettled as the month ended.

Lead was reduced to 4.75c., New York, a reduction of 25 points, owing to slack buying and a gain in surplus stocks. Inquiry for lead improved late in the month.

Imports of slab zinc during November amounted to 1,904 tons, against 9,338 tons in October and 14,741 tons in September. Demand was dull all month and the price settled at 5c., St. Louis.

The Tin Committee fixed production quotas for the first quarter of 1938 at 70 per cent. The rate in the last quarter of 1937 was 110 per cent.

The Government agreed to purchase foreign silver at unchanged prices during January and also established the domestic price as of Jan. 1, 1938, at 64.64c. This news brought out a better feeling in silver circles as the year ended.

UNITED STATES MARKET

1937 Dec.	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1	10.275	9.775	43.250	5.00	4.85	5.25
2	9.775 @ 10.275	9.825	43.500	5.00	4.85	5.00
3	9.775 @ 10.275	9.850	44.125	5.00	4.85	5.00
4	10.275	9.925	44.875	5.00	4.85	5.00
6	10.275	10.050	44.875	5.00	4.85	5.00
7	10.150 @ 10.275	10.000	43.875	5.00	4.85	5.00
8	10.150 @ 10.275	10.000	43.750	5.00	4.85	5.00
9	10.025	9.875	44.000	5.00	4.85	5.00
10	10.025	9.775	44.750	5.00	4.85	5.00
11	10.025	9.700	45.400	5.00	4.85	5.00
13	10.025	9.675	44.125	5.00	4.85	5.00
14	10.025	9.550	43.375	5.00	4.85	5.00
15	10.025	9.550	43.250	5.00	4.85	5.00
16	9.900	9.575	43.500	4.75	4.60	5.00
17	9.900	9.675	42.625	4.75	4.60	5.00
18	9.900	9.725	42.500	4.75	4.60	5.00
20	9.900	9.725	42.250	4.75	4.60	5.00
21	9.900	9.725	42.000	4.75	4.60	5.00
22	9.900	9.750	42.750	4.75	4.60	5.00
23	9.900	9.700	42.175	4.75	4.60	5.00
24	9.900	9.675	42.000	4.75	4.60	5.00
25	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
27	9.900	9.675	42.000	4.75	4.60	5.00
28	9.900	9.500	41.000	4.75	4.60	5.00
29	9.900	9.375	41.125	4.75	4.60	5.00
30	9.900	9.425	41.250	4.75	4.60	5.00
31	9.900	9.500	41.000	4.75	4.60	5.00
For month Average	10.006	9.714	43.051	4.875	4.725	5.010
Dec.	AVERAGES FOR WEEK					
1	10.475	9.617	42.450	5.00	4.85	5.25
8	10.171	9.942	44.167	5.00	4.85	5.00
15	10.025	9.688	44.150	5.00	4.85	5.00
22	9.900	9.696	42.604	4.75	4.60	5.00
29	9.900	9.585	41.660	4.75	4.60	5.00
Dec.	CALENDAR WEEK AVERAGES					
4	10.275	9.800	43.438	5.000	4.850	5.125
11	10.129	9.900	44.442	5.000	4.850	5.000
18	9.963	9.625	43.229	4.875	4.725	5.000
25	9.900	9.715	42.235	4.750	4.600	5.000

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(*a*) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and delivery charges.

(*b*) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(*c*) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57. Handy & Harman's quotation for domestic silver, .999 fine, was 77c. per ounce throughout December.

(*d*) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

1937 Dec.	Sterling Exchange "Checks"	Sterling Exchange "90-day demand"	Silver (c) New York	Silver (c) London	Gold London	Gold (d) United States
1	4.98500	4.97750	44.750	19.6875	140s ½d	$35.00
2	4.99000	4.98250	44.750	19.6250	140s	35.00
3	4.99000	4.98250	44.750	19.5625	139s 11½d	35.00
4	4.99125	4.98250	(e)	19.4375	139s 11½d	35.00
6	4.99750	4.98875	44.750	18.4375	139s 11d	35.00
7	4.99875	4.98875	44.750	18.5000	139s 9d	35.00
8	4.99500	4.98625	44.750	18.6250	139s 11d	35.00
9	4.99500	4.98500	44.750	18.9375	139s 10d	35.00
10	5.00000	4.99125	44.750	18.9375	139s 10d	35.00
11	4.99875	4.99000	(e)	18.8125	139s 10d	35.00
13	4.99625	4.98750	44.750	18.5000	139s 11d	35.00
14	4.99625	4.98750	44.750	18.6875	139s 10d	35.00
15	4.99750	4.98875	44.750	18.6875	139s 9½d	35.00
16	4.99625	4.98750	44.750	18.6875	139s 9½d	35.00
17	4.99500	4.98625	44.750	19.0625	139s 9d	35.00
18	4.99625	4.98750	(e)	18.9375	139s 9½d	35.00
20	4.99625	4.98750	44.750	19.0000	139s 9½d	35.00
21	4.99500	4.98500	44.750	18.8750	139s 9d	35.00
22	4.99625	4.98625	44.750	18.6875	139s 8d	35.00
23	4.99625	4.98750	44.750	18.5000	139s 8d	35.00
24	4.99500	4.98625	44.750	18.4375	139s 7½d	35.00
25	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
27	4.99500	4.98500	44.750	Holiday	Holiday	35.00
28	4.99500	4.98500	44.750	18.1875	139s 7d	35.00
29	4.99500	4.98625	44.750	18.4375	139s 6½d	35.00
30	4.99500	4.98625	44.750	18.5625	139s 6d	35.00
31	4.99500	4.98625	44.750	19.0625	139s 6d	35.00
Average for Mo.	4.99510	.....	44.750	18.835	.....	35.00
Dec.	AVERAGES FOR WEEK					
1	4.99125	.....	44.750	.....	.....	.....
8	4.99375	.....	44.750	.....	.....	.....
15	4.99729	.....	44.750	.....	.....	.....
22	4.99583	.....	44.750	.....	.....	.....
29	4.99525	.....	44.750	.....	.....	.....

Calendar week averages: New York Silver, 4th, 44.750; 11th, 44.750; 18th, 44.750; 25th, 44.750.

(*e*) No quoted; Saturday.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1937 Dec.	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
1	40.1250	40.3750	44.0000	191.7500	191.0000	16.2500	16.3750	16.3750	16.4375	15.9375	16.0000	16.1250	16.1875
2	39.8750	40.1250	44.0000	192.5000	191.5000	16.1250	16.1875	16.1875	16.2500	15.7500	15.8125	16.0000	16.0625
3	40.5000	40.7500	45.0000	194.6250	193.6250	16.3750	16.4375	16.4375	16.5000	15.8750	15.9375	16.1250	16.1875
6	41.4375	41.6875	46.0000	200.5000	199.7500	16.8750	16.9375	17.0000	17.0625	16.2500	16.3125	16.5000	16.5625
7	40.4375	40.6250	44.5000	197.0000	195.7500	16.1875	16.2500	16.2500	16.3125	15.6875	15.7500	15.9375	16.0000
8	40.2500	40.4375	44.5000	194.7500	193.7500	16.1250	16.1875	16.1875	16.2500	15.5000	15.6250	15.7500	15.8125
9	39.8750	40.0625	43.5000	193.0000	192.2500	15.7500	15.8125	15.8125	15.8750	14.8750	14.9375	15.0625	15.1250
10	40.1875	40.3750	44.0000	197.0000	196.0000	15.9375	16.0000	16.0625	16.1250	14.8750	14.9375	15.1250	15.2500
13	40.0000	40.1875	44.0000	199.0000	198.2500	16.2500	16.3750	16.4375	16.5000	15.0625	15.1250	15.3125	15.3750
14	39.1250	39.3750	43.2500	190.5000	189.5000	15.6250	15.6875	15.8125	15.8750	14.8125	14.8750	15.0000	15.1250
15	39.5000	39.6875	43.2500	190.7500	190.0000	15.6875	15.7500	15.8125	15.8750	14.8750	14.9375	15.1250	15.1875
16	40.0625	40.3125	44.0000	191.7500	191.0000	15.8125	15.8750	15.9375	16.0000	15.1250	15.2500	15.3750	15.5000
17	39.8750	40.1250	44.0000	190.5000	189.7500	15.7500	15.8125	15.8750	15.9375	15.0000	15.1250	15.3125	15.3750
20	40.0625	40.2500	44.0000	186.2500	185.5000	15.5000	15.5625	15.5625	15.6250	15.0625	15.1250	15.1875	15.2500
21	40.5000	40.7500	44.0000	188.5000	187.7500	15.7500	15.8750	15.9375	16.0000	15.4375	15.5000	15.5000	15.5625
22	40.3750	40.6250	44.0000	189.1250	188.7500	15.6250	15.7500	15.8125	15.8750	15.3750	15.5000	15.3750	15.5000
23	39.8750	40.1250	44.0000	187.1250	186.7500	15.6250	15.6875	15.7500	15.8125	14.9375	15.0000	15.0625	15.1250
24	39.9375	40.1875	44.0000	186.2500	185.7500	15.6250	15.7500	15.7500	15.8125	15.1250	15.1875	15.2500	15.3125
27							Holiday						
28	39.3125	39.5000	43.0000	183.0000	182.5000	15.6250	15.7500	15.7500	15.8125	15.0625	15.1875	15.0625	15.1250
29	38.8750	39.0625	42.0000	181.0000	181.0000	15.5000	15.5625	15.5000	15.5625	14.8750	15.0000	14.8750	14.9375
30	39.2500	39.5000	43.0000	183.2500	183.0000	15.5000	15.5625	15.4375	15.5000	14.8750	14.9375	14.8125	14.8750
31	39.3750	39.6875	43.5000	181.7500	181.7500	15.5000	15.6250	15.5000	15.5625	14.7500	14.8750	14.7500	14.8125
Average for month	39.946	.....	43.886	190.449	.....	15.905		15.994		15.274		15.429	

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton of 2,240 lb.

CURRENT PRICES—MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated
(January 3, 1938)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	20c.
Antimony, domestic, spot, lb	13.750c.
Bismuth, ton lots, lb	$1.00
Cadmium, lb	$1.00 @$1.35
Calcium, lb., ton lots 98 @ 99 per cent	75c.
Chromium, 97 per cent grade, lb	85c.
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	30c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$36.00
Quicksilver, flask of 76 lb., 100 flasks or more	$80@$81
Radium, mg. radium content	$40.00
Selenium, 99.5 per cent, lb	$2.00
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75@$2.00
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$6.00
Zirconium, commercially pure, lb	$7.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45 @ 47 per cent, c.i.f. Atl. ports, long ton	$22.00@$23.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent Joplin, Mo., ton	$52.93
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52 @ 55 per cent	45c.
50 @ 52 per cent	45c.
44 @ 48 per cent	40c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$25.00
Domestic Scheelite	a$22.00@$25.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc, Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$32.00

(a) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.67@$1.77
Copper Sulphate, 100 lb	$4.50
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.34
Sodium Sulphate, bulk, ton	$13.00@$15.00

ALLOYS

Beryllium Copper, Master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	10½c.
Ferromanganese, 78 @ 82 per cent, gross ton	$102.50
Ferromolybdenum, 50 @ 60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$2.00

NON-METALLIC MINERALS

Asbestos, f.o.b. mines ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$12@$16.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$7.00
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.50@$7.50
Domestic, abrasive, 70 @ 84 per cent	$12.50@$15.00
Dalmatian, 50 @ 55 per cent	(a)$6.50@$7.50
French, 56 @ 59 per cent	(a)$8.00@ 9.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.50@$8.50
Delaware, No. 1	$14.50@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$20.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$25.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in	15@40c.
2 x 2 in	30@60c.
3 x 3 in	75@$1.20
3 x 4 in	$1.00@$1.40
4 x 6 in	$2.00@$2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@12½c
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$15.00@.....
200 mesh, cream colored	$25.00@.....

(a) Nominal.

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$37.00
Structural shapes, 100 lb	$2.25
Bars, 100 lb	$2.45

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1936	1937	1936	1937	1936	1937
January	47.250	44.913	20.250	20.734	496.115	490.670
February	44.750	44.750	19.796	20.083	499.908	489.307
March	44.750	45.130	19.663	20.677	496.952	488.412
April	44.892	45.460	20.245	20.740	494.139	491.524
May	44.869	45.025	20.248	20.346	496.850	493.835
June	44.750	44.818	19.770	20.022	501.817	493.404
July	44.750	44.750	19.590	19.986	502.178	496.582
August	44.750	44.750	19.490	19.848	502.519	498.043
September	44.750	44.750	19.579	19.889	503.455	495.145
October	44.750	44.750	19.977	19.942	489.755	495.395
November	45.431	44.750	21.050	19.707	488.727	499.467
December	45.352	44.750	21.238	18.835	490.670	499.510
Year	45.087	44.883	20.075	20.067	496.924	494.275

New York quotations for silver not eligible for sale to U. S. Government, entsceper ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot (a)			
	Domestic		Export		Standard		Electrolytic	
	1936	1937	1936	1937	1936	1937	1936	1937
January	9.025	12.415	8.358	12.112	34.706	51.497	38.788	56.288
February	9.025	13.427	8.566	13.828	35.313	59.225	39.463	64.013
March	9.025	15.775	8.708	16.590	36.040	72.339	40.227	76.167
April	9.169	15.121	8.849	14.692	36.975	62.506	41.131	66.614
May	9.275	13.775	8.819	13.999	36.690	61.118	40.839	63.684
June	9.275	13.775	8.790	13.492	36.324	55.696	40.357	61.409
July	9.352	13.775	8.993	13.817	37.217	56.412	41.228	62.807
August	9.525	13.775	9.297	13.926	38.259	57.143	42.375	63.595
September	9.525	13.530	9.523	12.984	38.915	52.989	43.267	58.966
October	9.563	11.838	9.669	11.207	40.980	45.384	45.295	50.619
November	10.161	10.797	10.349	9.850	43.932	39.321	48.467	44.023
December	10.763	10.006	10.835	9.714	45.946	39.916	50.364	43.886
Year	9.474	13.167	9.230	13.018	38.441	54.465	42.650	59.339

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1936	1937	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.500	6.000	4.350	5.850	15.397	15.494	27.272	27.150
February	4.515	6.239	4.365	6.089	16.022	16.141	28.319	28.328
March	4.600	7.190	4.450	7.040	16.608	16.767	33.027	32.979
April	4.600	6.175	4.450	6.025	16.097	16.234	26.014	25.878
May	4.600	6.000	4.450	5.850	15.530	15.601	24.000	23.891
June	4.600	6.000	4.450	5.850	15.170	15.259	22.878	22.759
July	4.600	6.000	4.450	5.850	15.856	15.954	23.932	23.703
August	4.600	6.452	4.450	6.302	16.772	16.859	22.606	22.670
September	4.600	6.400	4.450	6.250	18.009	17.974	20.990	21.044
October	4.631	5.740	4.488	5.590	18.446	18.375	18.259	18.318
November	5.114	5.033	4.964	4.883	21.723	21.693	16.706	16.714
December	5.554	4.875	5.406	4.725	25.560	25.503	15.905	15.994
Year	4.710	6.009	4.560	5.859	17.599	17.655	23.326	23.286

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits, New York		Standard, Spot, London	
	1936	1937	1936	1937
January	47.234	50.925	209.731	229.350
February	47.962	52.010	207.081	233.750
March	48.037	63.043	213.080	282.988
April	46.963	59.172	209.313	267.136
May	46.352	55.651	202.429	250.645
June	42.204	55.851	183.167	249.852
July	43.021	59.245	185.957	263.540
August	42.579	59.465	183.731	264.595
September	44.754	58.675	194.676	258.943
October	44.975	51.654	201.193	223.869
November	51.392	43.299	230.869	190.477
December	51.823	43.051	232.108	190.449
Year	46.441	54.337	204.445	242.133

New York quotations cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.848	5.847	14 488	14.719	21.153	21.281
February	4.859	6.465	15 125	15.391	25.122	25.322
March	4.900	7.381	15.983	16.190	33.188	33.405
April	4.900	7.010	15.181	15.334	26.216	26.344
May	4.900	6.750	14.536	14.777	23.092	23.365
June	4.880	6.750	13.896	14.122	21.409	21.528
July	4.783	6.923	13.579	13.826	22.568	22.693
August	4.800	7.192	13.528	13.759	24.140	24.290
September	4.850	7.190	13.906	14.159	21.406	21.607
October	4.850	6.085	14.554	14.835	17.722	17.955
November	4.974	5.630	16.301	16.554	15.808	15.970
December	5.273	5.010	17.957	18.145	15.274	15.429
Year	4.901	6.519	14.920	15.151	22.258	22.432

St. Louis quotations, cents per pound. London, pounds sterling per long ton

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1936	1937	1936	1937
January	105.000	90.000	20.000	19.500
February	105.000	90.000	20.000	19.500
March	105.000	101.667	20.000	20.000
April	105.000	105.000	20.000	20.000
May	105.000	105.000	20.000	20.000
June	105.000	130.962	20.000	20.000
July	93.462	142.500	20.000	20.000
August	90.000	142.500	20.000	20.000
September	90.000	142.500	20.000	20.000
October	90.000	142.500	20.000	20.000
November	90.000	142.500	20.000	20.000
December	90.000	132.888	20.000	20.000
Year	97.789	122.335	20.000	19.917

Aluminum in cents per pound, 99 per cent grade. Cadmium, cents per pound.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1936	1937	1936	1937	1936	1937
January	12.736	14.130	76.769	90.250	36.885	50.400
February	12.967	14.563	77.000	91.000	35.000	64.364
March	13.072	16.375	77.000	91.778	34.115	58.000
April	12.673	16.043	76.731	92.000	32.846	58.000
May	12.410	14.830	74.940	95.520	32.000	54.800
June	11.707	14.702	74.192	96.654	36.346	53.000
July	11.245	14.803	73.423	93.904	39.308	50.115
August	11.125	15.327	73.923	91.423	49.577	51.000
September	11.740	16.555	85.280	89.020	68.960	51.000
October	12.058	16.935	89.240	86.140	54.074	48.560
November	12.233	15.848	90.250	83.435	48.000	43.652
December	12.918	14.144	90.250	81.038	48.000	38.385
Year	12.240	15.355	79.917	90.180	42.926	51.773

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1936	1937	1936	1937	1936	1937
January	20.00	21.50	19.00	20.50	19.50	21.00
February	20.00	21.50	19.00	20.50	19.50	21.00
March	20.00	24.20	19.00	23.20	19.50	23.70
April	20.00	24.50	19.00	23.50	19.50	24.00
May	20.00	24.50	19.00	23.50	19.50	24.00
June	20.00	24.50	19.00	23.50	19.50	24.00
July	20.00	24.50	19.00	23.50	19.50	24.00
August	20.00	24.50	19.00	23.50	19.50	24.00
September	20.00	24.50	19.00	23.50	19.50	24.00
October	20.00	24.50	19.00	23.50	19.50	24.00
November	20.23	24.50	19.23	23.50	19.73	24.00
December	21.00	24.50	20.00	23.50	20.50	24.00
Year	20.103	23.975	19.103	22.975	19.603	23.475

Iron in dollars per long ton. F. o. b. Mahoning and Shenango Valley furnaces.

PERSONAL ITEMS

A. W. Allen recently left California for Peru.

H. M. Hartmann is now manager of the Mountain City Copper Company, Rio Tinto, Nev.

Hal Williams Hardinge has been selected by the A.I.M.E. to receive the 1938 award of the James Douglas medal for achievement in non-ferrous metallurgy. The presentation will be made at the annual meeting in Feb-

HAL WILLIAM HARDINGE

ruary, with the citation: "For inventions of apparatus for fine grinding of ores, and achievements in improving practice in that art."

Albert Mendelsohn, former assistant general manager for Cananea Consolidated Copper Company, became general manager of the corporation on Jan. 1, 1938, succeeding Clyde E. Weed.

Walter L. Mattis is now manager and superintendent of the Marietta Mining & Milling Company at Alder, Mont.

Robert S. Cockle is now mine engineer on the staff of the Standard Silver-Lead Mining Company at Wilborn, Mont.

A. E. Thomas has resigned the position of chief metallurgist of Bulolo Gold Dredging, Ltd., and has been succeeded by **T. B. Laird.**

W. H. Wainwright formerly superintendent of the roasting and cyanidation sections of Wiluna Gold Mines, has joined the metallurgical staff of the Broken Hill Proprietary Company.

Lewis Plass, chief engineer of the American Smelting & Refining Company, who suffered an accident last fall, has completely recovered and has returned to his office in El Paso, Texas.

Clyde E. Weed has been appointed general manager of mines for Anaconda Copper Mining Company and its subsidiaries. Mr. Weed had been general manager for Cananea Consolidated since 1929.

Arthur Notman, consulting mining engineer, of New York, has been elected a director of Copper Canyon Mining Company, operating a gold-mining property in Nevada.

J. P. Sullivan, Jr., until recently at the Zeibright unit of Empire Star Mines Company, Ltd., Emigrant Gap, Calif., has joined the staff of Chile Exploration Company, Chuquicamata, Chile, South America.

L. S. Rivett, recently research engineer with Sisco Gold Mines, has been appointed experimental engineer at the concentrator of Falconbridge Nickel Mines, Ontario.

C. W. Nichols has resigned from the board of Canadian Copper Refiners, Ltd., which is controlled and in large part owned by Noranda Mines, Ltd., and has been succeeded by **Louis Cates,** president of Phelps Dodge Corporation. **R. G. Rudolph,** of Toronto, was appointed treasurer.

Charles W. Burgess, resident engineer in the Philippines for The Dorr Company since 1932, has returned to New York for a visit of several months, after which he will return to Manila.

Dr. George B. Waterhouse, professor of metallurgical production at the Massachusetts Institute of Technology and president of the American Society of Metals, has been awarded the honorary degree of doctor of metallurgy by the University of Sheffield, England.

William J. Asselstine, consulting metallurgist and for many years mill superintendent for Premier Gold Mining Company, Ltd., has been appointed Minister of Mines for the Province of British Columbia. He will also be Minister of Trade and Commerce, a new department established at the last legislative session. Mr. Asselstine is member for the Atlin district.

F. E. Lewis, of Terlingua, Tex., has severed his connection with the Chisos Mining Company, producer of quicksilver, but has remained in the district during the last month making a preliminary search for another location.

A. C. Hansen, superintendent of the Cambria mine of the Republic Steel Corporation, at Negaunee, Mich., has been appointed assistant general superintendent of the Witherbee Sherman Company mining operations at Port Henry, N. Y., which have been recently taken over by the Republic company. **T. F. Myners** has been made general superintendent of the New York ore properties.

John J. Curzon, recently superintendent of Eureka Mining & Smelting Company, Republic, Wash., is now acting as chief engineer of the Chelan Copper Mine, at Holden, Wash., which is owned by The Howe Sound Company.

Walter J. Eaton has returned to San Juan Capistrano, Calif., after having spent the past year in the Philippines examining gold, chromite, and manganese properties in many parts of the Islands.

P. R. Middleton has been appointed assistant mining engineer to Australian Mines Management and Secretariat (which represents the de Bernales interests), with headquarters at Kalgoorlie, W.A.

W. H. Blackburn has returned to San Francisco from Nevada and will be located at 1022 Crocker Building. He will divide his time between the Treadwell Yukon Mining Company, Ltd., and outside engagements in mining work.

W. F. Boericke has accepted a two-year contract with the Philippine Government as valuation engineer in the Islands, and has resigned his position with the Securities and Exchange Commission, at Washington, D. C., a

W. F. BOERICKE

post which he had held since December of 1934 as senior mining engineer, his work involving examination of mining companies which sought registration with the Commission. Mr. Boericke expects to become associated with **H. Foster Bain** in his new position in Manila.

Harvey S. Mudd has returned to the United States from the island of Cyprus, where he has a financial interest in Cyprus Copper Corporation. After spending a few days in New York City, Mr. Mudd went to Los Angeles, where he resides.

S. J. Clausen, Jr., formerly connected with the Howe Sound Company as general superintendent at two of its subsidiary units in Mexico for several years, and later as exploration engineer in the United States and Mexico, is now general manager of the Cia. Exploradora de Minerales y Metales, S. A., Apartado 1, Campostela, Nayarit, Mexico. The Exploradora company operates silver-gold properties and a flotation mill near Campostela.

Information Wanted

THE BOLIVIAN CONSUL, Los Angeles, Calif., requests aid in locating **David F. Kirkwood**, and offers the following information: Mr. Kirkwood came to the United States from Bolivia in 1916 and entered the Colorado School of Mines. His family last heard from him in 1923. Their last letter addressed to him at Cripple Creek, Colo., brought no reply. Anyone in the mining industry knowing anything of Mr. Kirkwood's whereabouts will render a kind service to his family by communicating with Duke N. Banks, Consul de Bolivia, Los Angeles, Calif., U.S.A.

Enoch Perkins, of the Mutual Chemical Company of America, sailed on Jan. 4 for visits to Turkey, the Union of South Africa, and Southern Rhodesia. He expects to return to New York the end of April.

Percy A. Seibert, general representative, Braden Copper Company, Santiago, Chile, has received from the Chilean Republic the decoration of the order "Al Merito," with the rank of Knight Commander. The honor was conferred on him in recognition of his distinguished services to Chile since 1926.

Dr. Charles Palache, chairman of the department of mineralogy at Harvard, received the Roebling gold medal at the meeting of the Mineralogical Society held in Washington, D. C., on Dec. 29. The medal, named in honor of William A. Roebling, a former vice-president of the Society, was awarded for the first time on the occasion noted. Dr. Palache retired last month as president of the Geological Society.

G. G. Griswold, Jr., has returned to Butte after spending several months in the Taku district, northern British Columbia, where he has completed the construction of a 200-ton flotation mill for the Taku Gold Mining Company, which is controlled by the Congdon interests, of Duluth.

John Hatfield, of Wenatchee, Wash., has purchased the twelve lode claims covering a tungsten deposit in Okanogan County, one mile south of the Canadian line, on the Wolframite and Scheelite mountains. This property was formerly owned by Ferris Ford and associates, of Okanogan. During 1915-17 it was operated under lease by the Granby Consolidated Mining, Smelting & Power Company, Ltd. Equipment is being assembled for a small-scale operation starting in the early spring of 1938.

J. A. Siefert, mining engineer and geologist for the Nicholson Creek Mining Corporation, 300 Insurance Building, Seattle, Wash., has returned from the company's property at Usk, B. C., where he has been in charge of development work during the past season. After completing reports at the company's office at Seattle, he will devote the next few months to a California property, returning to Usk in June of 1938. His Oakland, Calif., address is 1114 Wellington St.

Howard I. Young, of St. Louis, Mo., was reelected president of the American Mining Congress at its 40th annual convention in Washington, D. C., on Dec. 3. **William E. Goodman**, of Chicago, and **Merrill E. Shoup**, of Colorado Springs, were elected to serve three years on the governing board. All the other officers of the Congress were reelected: **D. D. Moffat**, of Salt Lake City, first vice-president; and **Julian D. Conover**, of Washington, D. C., secretary.

Dr. Arthur L. Day, recently retired director of the Geophysical Laboratory of the Carnegie Institution of Washington, was on Dec. 28 last elected to the presidency of the Geological Society of America at its meeting in Washington, D. C. He succeeds **Dr. Charles Palache**, of Harvard University. **Dr. Charles P. Berkey**, of Columbia, was reelected secretary of the Society and **Dr. Edward B. Mathews**, Johns Hopkins University professor and Maryland State Geologist, treasurer.

Francis W. Maclennan, who since June of 1913 has been general manager of Miami Copper Company, was on Dec. 9, 1937, appointed vice-president and consulting engineer of the company by its board of directors. **A. S. Winther**, former general manager of Rhokana Corporation, in Northern Rhodesia, assumes Mr. Maclennan's post as general manager. Mr. Maclennan joined the Miami organization in 1913 as mine superintendent, later serving as assistant general manager. In 1931 he was awarded the Saunders Gold Medal of the A.I.M.E. for establishing a record in the treatment of the lowest-grade ore theretofore produced on a commercial basis. This award was first established in 1927 and had been received by only four others: Messrs. Brunton, Hoover, Hammond, and Jackling. In addition to the Saunders gold medal he also received in 1931 the degree of LL.D. from McGill University for his achievement in mining. Mr. Maclennan's early professional career included work in British Columbia, Oregon, Utah, Nevada, and Peru.

OBITUARY

A. R. Chambers, a prominent Nova Scotia mining man, died in Montreal on Dec. 4 last at the age of 57.

E. A. Morley, long identified with mining in Montana, died on Dec. 19 at the age of 74.

Sir John Higgins, prominent metallurgist and adviser to the Commonwealth Government during the War period, died in Melbourne on Oct. 6 last at the age of 75.

Dr. Raymond Jackson Leonard, professor of geology, mining engineer, and dean of the graduate college of the University of Arizona, died at Tucson on Nov. 20 last at the age of 50.

Joseph H. Oleson, prominent in the mining and smelting industries of Utah and Montana for many years, died at Salt Lake City on Dec. 11.

Karl Brooks Heisey, president of Shanshaw Mines, Ltd., and well known throughout Quebec as a consulting mining engineer, died in Toronto on Dec. 7 at the age of 42.

Berthel B. Berthelson, recently appointed superintendent of the Zeibright unit of Empire Star Mines Company, Ltd., Emigrant Gap, Calif., died in San Francisco on Dec. 4. He was a graduate of the University of Stockholm, and after his arrival in the United States in 1921 held executive positions in Colorado, Nevada, Arizona, and Mexico. He was 42 years of age.

Ivan Harry Barkdoll, general superintendent of the Copper Queen branch of Phelps Dodge Corporation, at Bisbee, Ariz., died suddenly in Chicago on Dec. 1 last while returning to Arizona from New York. Mr. Barkdoll was 61 years old. He had long been identified with mining in Arizona. He was a member of the A.I.M.E. and had held office, at various times, in the Arizona Chapter of the American Mining Congress.

A. Bruce Ritchie, general superintendent of the Sullivan mine of Consolidated Mining & Smelting Company, at Kimberley, East Kootenay, B. C., was instantly killed recently by a fall of rock after a blast in a stope.

Michael A. Smirnoff, geologist, a native of Russia and a graduate of the Colorado School of Mines, died suddenly at Houston, Tex., on Nov. 23, 1937, of heart failure. His wife, **Louise McConnell Smirnoff**, died two days later of grief. Formerly for several years on the staff of the Roxana Petroleum Corporation, a subsidiary of the Royal Dutch Shell Company, Mr. Smirnoff had lately been engaged in consulting practice at Houston.

George Manville Robison, a prominent mining man of Morenci, Ariz., since 1891, died in that city on Nov. 23 last. Mr. Robison was born in East Springfield, Pa., was a graduate of Lafayette College, and was a mining engineer in Leadville, Colo., when that camp was established. He went to Morenci in 1891 to work as chief engineer for the Detroit Copper Company and later served in the same capacity for Phelps Dodge. Since 1932 he had been acting as a consultant.

Charles Janin, well-known consulting engineer, long an important member of the California mining fraternity, and the son of Louis Janin, died at his home in Piedmont, Calif., on Nov. 30, aged 64. Mr. Janin started his mining career in the Home mine, Nevada City, Calif. Later he joined his father, assisting him in mine examination and in mining litigation. He was next examining engineer for a syndicate headed by Jonathan Bourne, Jr. After four years of this work, Mr. Janin formed the firm of Janin, Stebbins & Smith, later Janin & Smith, and engaged in consulting work. In 1911, he opened his own office. Early in 1914, he joined the staff of the United States Bureau of Mines, and during the World War, for

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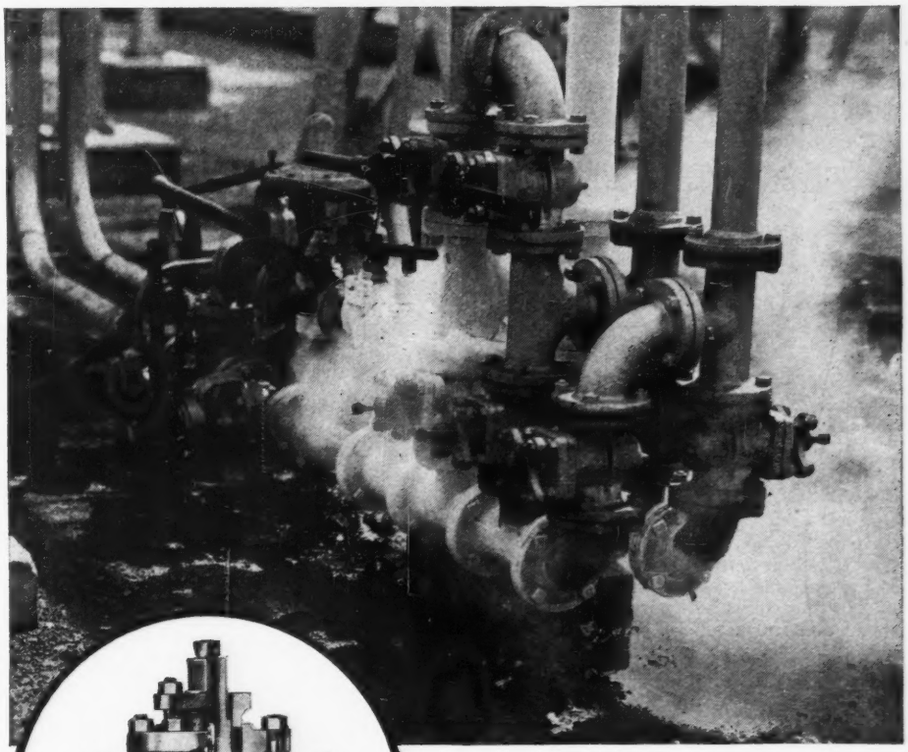
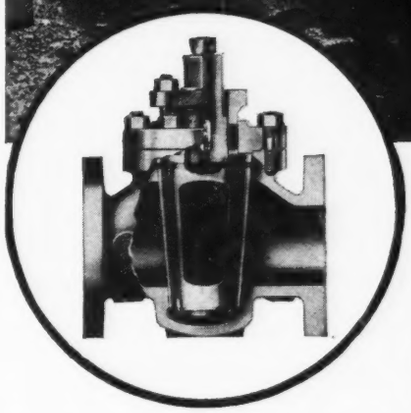


A battery of Walworth Lubricated Plug Valves on a propane line being defrosted by live steam.



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a part of 1917, and practically all of 1918, he actively participated in War work with the Bureau. Many contributions were made to the technical publications by Mr. Janin. He wrote Bulletin 127, "Gold Dredging in the United States," for the Bureau of Mines, and for the engineers and workers of the mining industry throughout the world. Mr. Janin was a member of the American Institute of Mining and Metallurgical Engineers and of the Institution of Mining and Metallurgy in London. A biographical appreciation of Mr. Janin's life and attainments was presented in *Engineering and Mining Journal* of May 29, 1920.

▼ ▼ ▼

Letters

Ore-Bin Design

The Editor:

SCANNING the October number of *E.&M.J.*, our eyes fell on the familiar form of an ore bin in the article by W. W. Staley. It impressed us as a well-proportioned structure, and our interest was aroused as to its evolution, having in mind particularly the present acute demand for economy. Although this viewpoint has in recent years run to extremes, it will never lose its importance, and we may therefore be pardoned for submitting what, we trust, may prove a helpful contribution.

Computing roughly the amount of lumber in the design shown, we find it to be (exclusive of substructure):

Total lumber in 100-ton bin, 8,600 b.ft.
lumber per ton of ore, 86 b.ft.
lumber per cu.ft.vol. 4.3 b.ft.

Our company has built a number of bins of this general type or form, and with careful placing of timber and steel reached for an average the low requirement of 52 b.ft. per ton of ore, or 2.6 b.ft. cu.ft. *live* volume, representing a saving on the above of some 40 per cent. Such a result calls for an explanation, especially if achieved on the very basis laid down by the undisputed analysis of the article referred to. The basic formulae of Rankin, and their application so helpfully shown by Professor Ketchum, furnish us the stress-conditions under full loading. If no superimposed loads, such as truck platform, sledging grizzly, or conveyor head-structure, are to be considered, the solution is easy. Side pressure on the uprights is given by the triangular diagram with

$P = 24h$ (in feet) at bottom
$P = O$ at top

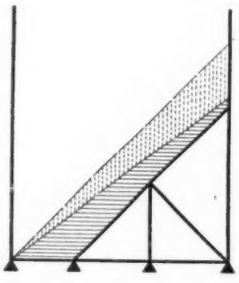
Derived from:

$$\text{Total side pressure } N = 1/2\ wh^2 \frac{1 - \sin x}{1 + \sin x}$$

$$= 12h^2 \text{ approximately.}$$

This load diagram may be divided into two or three sections by introducing necessary supports in the way of rods or wales to take the reactions. The distance between these wales is determined by the practical choice of beam section and its carrying distance for the corresponding loading as marked off on that diagram. For the short span thus obtained, horizontal shear determines the section and keeps it down. Nor are the wales massive if properly tied at points of load. Twin beams are preferably used for these, which avoid costly drilling for the big tension rods, and retain full effective area of beam.

Now, bins of this size usually being square, or nearly so, present similar loading for front and side posts, and the logical urge is to tie wales diagonally (across corners of the bin) rather than permit rods to cross and obstruct the free inside area of the bin. We thus obtain a structure resembling a shell



girded about with hoops approaching in character the most economical structure known, the circular tank. It is evident that the corners need but little reinforcing, and if front and side shell-boards are alternately carried over the corner post much like the logs of a block house, a small cleat (say 3 x 6 in.) suffices to hold the ends of all the short boards.

A profitable modification of the bin bottom is now suggested. A line drawn at the angle of repose from the lip of front gate to rear wall will indicate the surface of the ore remaining in the bin were the live content drained, the floor assumed to be below that. If we were to lay the floor to this line, we would at once increase the live capacity of the bin by 12 per cent for the suggested angle of 38 deg. (over 12 x 15 ft. clear projected bin area). We still have a self-emptying charge. Inasmuch as for other reasons we prefer a 45-deg. bottom slope, we may start its upper end at the point just marked off or slightly below, and land with the lower end somewhat back of the gate lip, requiring a short horizontal portion to complete it. This is desirable, as it traps a prism of ore (or waste) in the bin which effectually protects the bottom from the falling ore (not to speak of falling cars) without resorting to steel-plate lining.

The best execution, in our opinion, is obtained by dividing the base sill into three panels as shown in the diagram; that is, introducing two additional supports, locating the toe of the inclined bottom girder over the first one and inserting an auxiliary post above the second one. This little post will prove to be the most useful stick in the structure. It supplies the much-needed bearing area for the floor girder at its center support. Pressure across the grain at this point is excessive without resorting to a steel cap or oversize heel post.

We trust the foregoing is seen not as a criticism of the design exhibited in the article referred to, but rather an effort toward careful application, with a view to economy, of the values furnished by correct stress analysis.

E. A. MAAG,
Chief Designer, Mining Department
Southwestern Engineering Company, Los Angeles, Calif.

In reply to Mr. Maag's letter of Dec. 9, I should like to say that his suggestion regarding the use of the two additional supports and the vertical post under the floor beam, thus making available a "floor of ore" instead of timber, appears reasonable. However, without recalculating my entire design, I find that this additional timber practically equals that saved by inserting these new members. With respect to reinforcing the corners as he suggests (I have seen bins constructed in this fashion, and I see nothing objectionable to it), I find that a saving of a little more than 4 per cent would be made. These changes, apparently then, are not responsible for the 40 per cent discrepancy. At the time of designing the ore bin I found, according to Peele's "Mining Engineers Handbook" and Taggart's "Handbook of Ore Dressing," that somewhat over 100 b.ft. per ton was used in the design presented therein. Other sources ("Handbook of Mining Details," p. 170, McGraw-Hill Book Company, 1912) ran this up to over 200 ft. Without having definite information to the contrary I would say that in Mr. Maag's design a much higher unit stress for the timber was used. Consulting the "Wood Handbook," p. 105 (United States Department of Agriculture) we find that for Douglas fir, structural grade, the following stresses could have been used (under the conditions usually encountered I thought it doubtful if such timber would be available; therefore, I used a more conservative unit stress):

	Pounds per Square Inch Compression,		
	Bending	Perpendicular to Grain	Compression, End Bearing
Douglas fir, dense, all regions	2,333	380	1,711
Douglas fir, coast region	2,000	325	1,466
Douglas fir, used in ore bin design	1,400	300	1,200

I do not think it quite fair to base the boardfeet per ton on just that timber inclosing the ore. By making the bin shallow and narrow, and stretching the length out (in other words making a low, narrow, long bin), the use of small members can be obtained for "surrounding" the ore. However, this is more than made up, in many cases, by the increased amount of timber in the supporting substructure.

Moscow, Idaho. W. W. STALEY

What Metal Statistics Show

NON-FERROUS METAL producers witnessed a further increase in stocks of copper, lead, and zinc during the last month of 1937 as the general business slump deepened. Curtailment in copper production announced by producers late in September was reflected in the November statistics showing 59,756 tons (blister) produced, compared to 71,238 tons in October, a decrease of 11,482 tons. A further decrease in production is anticipated by the industry in the December figures. Apparent consumption continued to decline here, and producers believe curtailment now in effect is rapidly approaching a more balanced position between demand and supply, thereby creating a sounder condition for the whole industry while waiting for business improvement. In November, domestic stocks of refined copper increased 38,765 tons while blister stocks decreased 5,892 tons, so that the net change in combined stocks of blister and refined was an increase of 32,873 tons. Abroad, the picture was different, refined stocks decreased 8,083 tons and blister stocks declined 602 tons and apparent consumption in November reached 120,696 tons, a new high. World stocks of refined copper at the end of November totaled 413,846 tons, an increase of 30,682 tons compared with October.

Following is a summary of the statistics for October and November, in short tons:

	Oct.	Nov.
Production (blister):		
U. S. mine	71,238	59,756
U. S. scrap, etc.	9,199	10,142
Foreign mine	103,758	99,408
Foreign scrap, etc.	12,441	9,470
Totals	196,636	178,776
Production, refined:		
United States	87,030	75,790
Foreign	109,548	109,480
Totals	196,578	185,270
Deliveries to customers:		
Domestic	43,742	33,892
Foreign	114,191	120,696
Totals	157,933	154,588
U. S. exports of domestic copper	4,698	3,133
Stocks, refined:		
United States	182,911	221,676
Foreign	200,253	192,170
Totals	383,164	413,846

	Jan.-Nov. 1936	Jan.-Nov. 1937
Blister production	661,973	920,741
Refined production	669,807	903,713
Deliveries:		
Domestic	682,151	784,435
Export	47,780	58,670
Totals	729,931	843,105
Stocks, refined, Nov. 30	171,291	221,676

▶ **ZINC**—December was a dull month for zinc producers. Output of ore in the Tri-State district continued to decline, there being little demand for Prime Western grade by smelters. Announcement by General Motors of curtailment in automobile production makes producers of High Grade zinc eagerly scout prospects for any improvement in the first quarter of the new year.

Statistics of the Prime Western division, covering the ordinary grades for the year 1937 follow:

	Production	Shipments	Stock At End
Jan.	21,263	30,520	29,924
Feb.	19,703	27,349	22,278
March	21,973	28,402	15,849
April	21,333	25,921	11,261
May	23,553	24,321	10,493
June	22,482	22,719	10,256
July	25,237	25,311	10,182
Aug.	26,140	29,549	6,773
Sept.	27,412	24,670	9,515
Oct.	28,667	23,520	14,662
Nov.	25,475	19,079	21,058
Dec.	27,006	18,730	29,334

▶ **LEAD**—Though production of lead decreased in November, stocks of the metal increased 12,927 tons, a volume greater than most producers expected. Domestic shipments in November were only 33,853 tons, the lowest since May, 1936. Total stocks of refined lead on hand at the end of November were 113,573 tons. Many in the industry look for an increased demand for lead during the first quarter of 1938. The figures for October and November, in short tons, according to the American Bureau of Metal Statistics, follow:

	Oct.	Nov.
Stock at beginning	90,742	100,646
Production:		
Domestic ore	45,112	42,892
Secondary and foreign	4,085	3,904
Totals	49,197	46,796
Domestic shipments	39,292	33,853
Stocks at end	100,646	113,573

The following tabulation shows total lead stocks at the works of smelters and refiners in the United States so far as reported, in short tons:

	Oct. 1	Nov. 1
In ore, matte, process (a)	54,332	51,997
In base bullion:		
Smelters and refineries	9,497	11,008
In transit to refineries	2,020	3,028
In process at refineries	14,555	14,870
Refined lead	85,009	94,100
Antimonial lead	5,733	6,546
Total stocks	171,146	181,549

(a) At smelters.

Fairly complete statistics on world production of refined lead are again available, owing to the inclusion of data from Spain that cover most of the production from that area. World production for October was 164,659 short tons, according to the American Bureau of Metal Statistics. Production in the Jan.-Oct. period totaled 1,553,040 tons.

Production during September and October, by countries, on refined-lead basis, in short tons:

	Sept.	Oct.
United States (a)	37,989	45,112
Canada	16,920	17,781
Mexico	19,743	21,133
Austria and Yugoslavia	(e)1,700	(e)1,700
France	3,659	4,343
Germany	15,976	15,006
Italy	4,005	3,527
Poland	1,466	1,224
Other Europe (b)	17,500	17,300
Australia (c)	22,996	20,489
Burma	7,252	7,252
Tunis	2,926	992
Elsewhere (d)	6,900	8,800
Totals	159,032	164,659

(a) Domestic only. (b) Belgium, Russia, Great Britain, and Czechoslovakia; partly estimated. (c) Includes Australian lead refined in Great Britain. (d) Argentina, Peru, Japan, product of foreign ore smelted in U. S., and also inclusive of major part of the production of Spain. (e) Estimated or partly estimated.

Silver Production of the World

The following table shows silver production of the world according to the American Bureau of Metal Statistics, with some of the figures preliminary and subject to revision:

(In Thousands of Fine Ounces)

	May	June	July	Aug.	Sept.	Oct.	Jan.-Oct.
United States	5,280	5,487	6,805	7,441	5,779	4,855	56,940
Canada	1,467	1,228	2,317	2,367	2,271	2,536	17,984
Mexico	6,543	10,140	6,274	8,428	6,460	(a)	(a)
Peru	1,582	1,224	1,400	1,333	1,260	1,150	14,015
Other America	1,650	1,700	1,700	1,675	1,650	1,650	16,175
Europe	1,625	1,650	1,650	1,600	1,600	1,650	15,925
Australia, refined	760	804	791	819	919	863	7,685
Other Australia and New Zealand	400	350	350	375	425	450	3,925
Japan	844	844	768	(b)820	(b)820	(b)800	8,318
Burma, refined	520	510	520	515	510	505	5,180
Other Asia	310	310	310	300	300	280	3,075
South Africa	95	88	92	93	93	93	911
Belgian Congo	400	450	400	400	350	350	3,705
Other Africa	60	50	50	50	50	50	560
Total	21,536	24,845	23,427	26,216	.....	.....	.....
Total ex Mexico	14,993	14,705	17,153	17,788	16,027	15,232	154,393

(a) Not yet reported. (b) Conjectural.

Airplanes have transported many tons of machinery and supplies to Alaska's growing mining districts during the past year. Next spring, when fly nets are again the vogue in dress, even greater mining activity is anticipated

ALASKA

Mining Operations Growing Throughout Territory

Small gold dredges, tractors, and airplanes afford speedier and more efficient production—New large dredge will exploit platinum deposit of Goodnews Bay Mining Company on Salmon River

▶ Mining activities increased in many districts during the past year, and mineral areas indicating good prospects have been served by the growing use of airplanes and tractors. More than 90 per cent of the tractors in Alaska are used in the mining industry. According to the annual report of John W. Troy, Governor of Alaska, for the fiscal year ended June 30, 1937, the value of gold production was $11,328,000, or $1,600,000 above the record for the previous year. Total mineral production was valued at $23,594,000, compared to $18,312,000 the year previous. Labor troubles in the Copper River region, in addition to a two months' suspension of shipping between the States and Alaska, affected metal output during the year. About 39 dredges were in operation during 1937, their total yardage being estimated at 14,632,000 cu.yd., with an average of 60.9c. per cubic yard. Two new dredges are expected to be in operation next season. A new 8-cu.ft. Yuba dredge financed by an R.F.C. loan started operations early in November on an extensive platinum deposit of the Goodnews Bay Mining Company in the Salmon River. Machinery and equipment in increasing quantity are expected to be brought to scattered mines during the winter months, and barring unforeseen events, operators in Alaska are looking forward to a very active 1938.

▶ Antimony deposits in the Kantishna district are being developed by the National Lead Company, and steady production maintained during the summer months has been sorted and sacked, and will be transported by tractor sleds to steel and later shipped to points on the West and East coasts. About 800 tons of ore were shipped last winter and a larger amount is expected to have been produced during the summer.

▶ Finding platinum last year in the Goodnews Bay area resulted in considerable publicity for the town of Platinum, situated on the South Spit of Goodnews Bay. Platinum was first produced from the Goodnews Bay district in 1927. One of the producers of platinum is the Clara Creek Mining Company, that started operation in Clara Creek in July 1936. William Standberg is in charge of operations. A Northwest dragline, Caterpillar tractor, and a small ball mill and Wilfley table are used. Two Bucyrus Erie draglines and two Caterpillar tractors are employed in platinum operations of the Goodnews Bay Mining Company at Squirrel Creek. The company recently started operations on Salmon River of a new 8-cu.ft. dredge financed by a R.F.C. loan and manufactured by the Yuba Manufacturing Company, San Francisco. The dredge will dig to 50 ft. and is diesel electric driven and displaces about 1,320 tons.

▶ B. D. Stewart, Commissioner of Mines for Alaska, writes in the Fairbanks *Daily News-Miner* that the mining industry in Alaska is flourishing and during the past four years dredges in active operation have increased from 30 to 41 and the number of producing dragline units has increased from less than a half dozen to about 30. Employment in the same period increased from 3,400 to 4,600, of whom nearly 60 per cent are engaged in placer mining. Commissioner Stewart writes in part: "The widespread introduction of mechanical equipment of the dragline type, employed in conjunction with the movable washing plants and pumping units and supplemented by Caterpillar tractors and bulldozers has been in many respects the most important recent development in the placer mining field." Mr. Stewart says that extension of dependable airplane service to all sections of the territory has been another major factor in the recent increase of mining activity, especially in the placer mining field. During the past year facilities of the Department of Mines for assisting prospectors have been augmented in an important way by the establishment at College, Ketchikan, and Nome of free assay offices for Alaskan residents.

▶ United States Smelting, Refining & Mining Company operated five gold dredges during the last season on the Ester, Chatanika, Goldstream, Gilmore and Cleary creeks respectively. Dredging is also planned on the Pedro and Fish creeks in the Fairbanks area. Three dredges were also operated in the Nome area during the year, and the company has been prospecting in several mineral regions. Dredging operations usually begin in March and continue until early December. The company employs a method of using cold water for thrawing frozen ground instead of steam thawing. Roy E. Earling is manager of the Fairbanks exploration department and J. D. Harlan is manager of the company's subsidiary, Hammon Consolidated Gold Fields, at Nome.

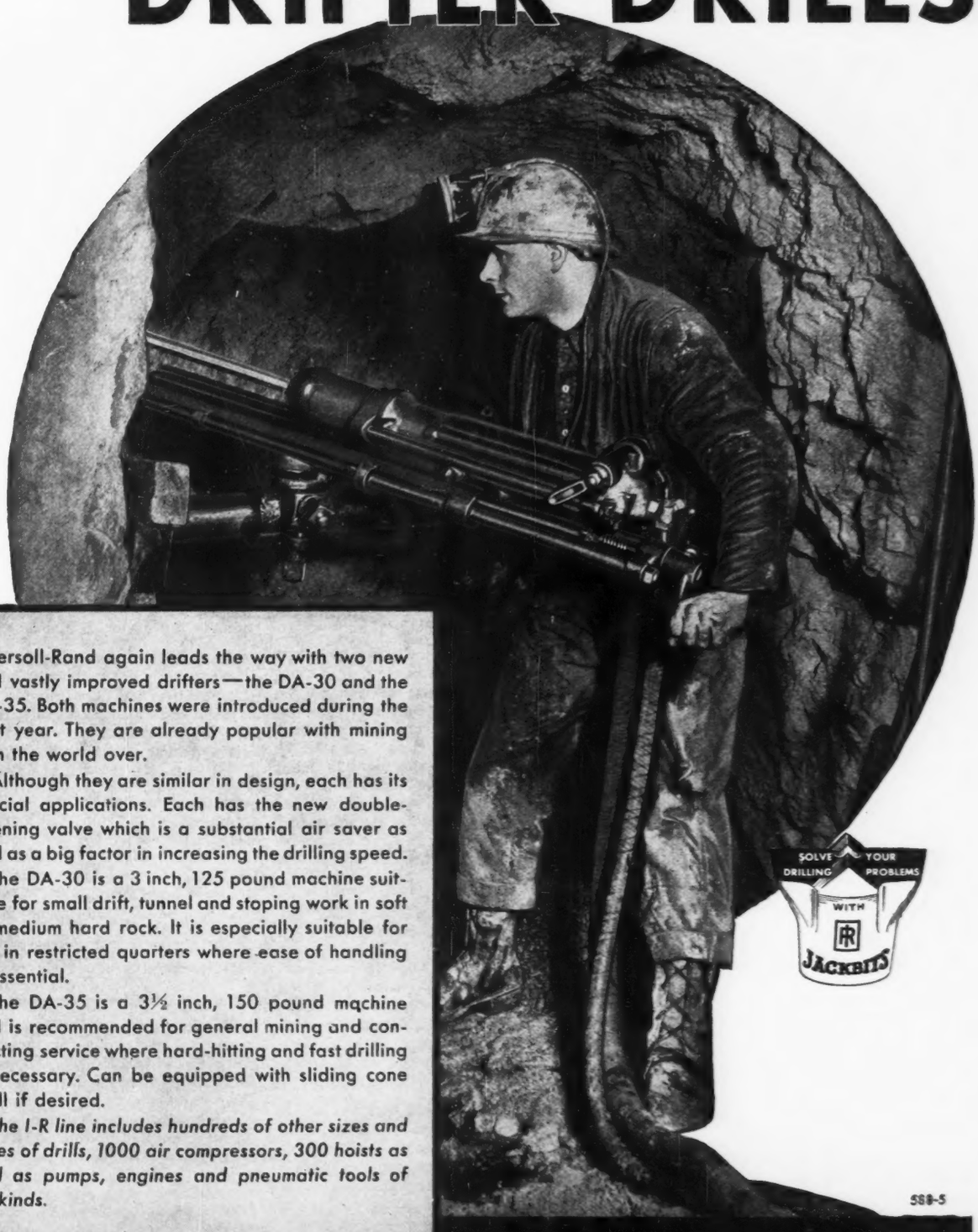
▶ The Joe and Fannie Quigley gold lode mines, on Quigley Hill, in the Kantishna district, were recently obtained by Earnest R. Fransen and Clifton M. Hawkins, of McKinley Park 4. During the winter months equipment for a 50-ton mill and other supplies will be hauled to the camp, and sufficient mine development is planned to begin production early in the second quarter.

▶ Hirst Chichagof Mining Company has completed plans for the installation of a 200-hp. diesel engine to increase power supply. Paul Sorenson, at Kimshan Cove, Alaska, is superintendent.

▶ William J. Porter and associates, with offices at 512 Radio Central Building, Spokane, Wash., have purchased the assets of the Pat McDonald, Inc., on Peters and Cache Creek, near Talkeetna, Alaska. The property is said to cover 20 miles of placer ground and is equipped with a 1½-yd. Bucyrus dragline and a washing plant. The enterprise will be known as the Spokane-Peters Creek Mining Company.

▶ Mining interests in South Africa are reported to be considering a program of prospecting and development covering an area near Carmacks and extending close to Dawson, Alaska. Completion of this program is estimated to require about $5,000,000, spent over the next few years. Preliminary work is said to be planned during 1938.

DA-30 AND DA-35 DRIFTER DRILLS



Ingersoll-Rand again leads the way with two new and vastly improved drifters—the DA-30 and the DA-35. Both machines were introduced during the past year. They are already popular with mining men the world over.

Although they are similar in design, each has its special applications. Each has the new double-opening valve which is a substantial air saver as well as a big factor in increasing the drilling speed.

The DA-30 is a 3 inch, 125 pound machine suitable for small drift, tunnel and stoping work in soft or medium hard rock. It is especially suitable for use in restricted quarters where ease of handling is essential.

The DA-35 is a 3½ inch, 150 pound machine and is recommended for general mining and contracting service where hard-hitting and fast drilling is necessary. Can be equipped with sliding cone shell if desired.

The I-R line includes hundreds of other sizes and types of drills, 1000 air compressors, 300 hoists as well as pumps, engines and pneumatic tools of all kinds.

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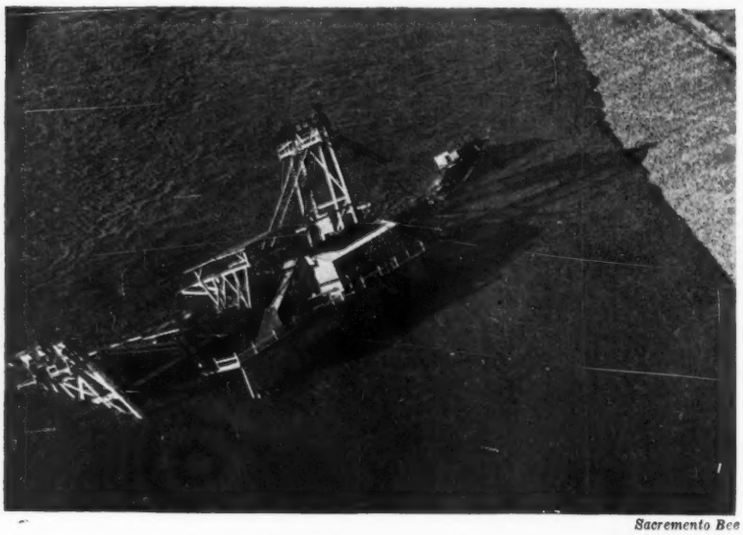


Sacramento Bee

Heavy rains early in December wrecked mining machinery and equipment in the Downieville district of California. Above is the dredge of the Oroville Dredging Company that was ripped from its moorings and beached on a high bank in the Feather River

CALIFORNIA

Tungsten and Beryllium Deposits Being Developed

Producers seek to maintain ample tungsten supplies from domestic mines over uncertainty of imports from China—Debris-dam construction expected this year

▶ Actual construction work in less than six months on the $6,220,000 débris-dam project in central California is expected by Major W. E. Harris, United states Army Engineers, member of the California Débris Commission. Plans to revive a once-prosperous hydraulic-mining industry include construction of four dams on the Yuba, American, and Bear Rivers, and current activities are chiefly centered in preliminary surveys and investigation of chosen dam sites. The dam projected on the Yuba River near Smartsville is estimated to cost $4,595,000, and dams on the North and Middle forks of the American River $825,000 and $800,000 respectively.

▶ The Beryllium Company, Inc., of San Francisco, is developing a beryllium deposit near Vista, San Diego County, under the direction of Edgar R. Larson, metallurgist. Upon completion of a comprehensive development program, ore will be mined by open-pit methods and treated in a 100-ton plant, which is to replace the present 5-ton pilot mill at a later date.

▶ Higher prices for tungsten during the past several months have brought about a substantial revival of mining activity in the Bishop district, Inyo County, where several new properties are being prepared for production. The 40-ton mill of Bishop Tungsten Company is operating at capacity, and the Tungsten Milling Company and El Diablo Mining Company each have a 100-ton and 50-ton plant in operation respectively. New mills are being planned by the United States Vanadium Corporation and Pacific Tungsten Company.

▶ Milling operations are to be increased to 150 tons upon completion of a 100-ton unit now under construction at the plant of Bagdad Chase-Roosevelt mines, at Daggett, operated under a purchase agreement by F. L. C. d'Aix, of Chicago. The present 60-ton plant is being operated practically at capacity on ore obtained from the mines situated near Ludlow. Treatment is by flotation and cyanide methods. Carl L. d'Aix, general manager, is in charge of operations, and fourteen men are employed.

▶ California Bonanza Mines, Inc., has recently completed the installation of a 50-ton mill at the Top Nest mine, near Twenty-Nine Palms. About sixteen men are employed at the property, which produces a gold-silver-copper ore. Howard W. Squires is president and general manager of the company, with L. Rudloff, superintendent, in charge of operations.

▶ Dewatering of the old Fortuna mine, south of Nevada City, is progressing rapidly, and preliminary mining is scheduled to commence soon. Electric power has recently been extended to the property. J. M. Hoff is in charge of operations.

▶ At the mine of Penon de Oro Mines Company, J. F. Michael, of San Francisco, lessee, is erecting a 100-ton mill and machinery for a hydro-electric power plant. The property is near Buck Meadows, and consists of four claims.

▶ The Neria Quicksilver Mining Company, operating at Idria, San Benito County, has increased production from 80 to 160 tons a day after placing in operation a second Gould rotary furnace and installing a new condensing system. H. W. Gould is general manager, and about 85 men are employed at the property under the direction of C. H. Lewis, superintendent.

▶ George Holmes and associates are reported to have leased the Middle Buttes mines, near Mojave, and worked until recently by the Walter Trent interests. The moderate weekly tonnage of ore shipped to the Golden Queen mill for treatment is mined from an extension of the glory hole, where four faces on two levels are being worked. Six feet of ore is reported to be available in a winze sunk from a tunnel 100 ft. below the glory hole. To the west on the Ella vein, ore obtained from a vein from 8 to 12 ft. wide is being stockpiled. Diamond drilling is in progress at the adjoining property, also controlled by Holmes, in an effort to locate orebodies believed to dip off the Buttes and under the floor of the valley. P. Drew, foreman, and ten men are employed at the Middle Buttes property.

▶ In the Auburn mining area, operations have been temporarily suspended at the TWA mine, and a new shaft is being sunk at the Blue Eagle mine, which is equipped with a 50-ton mill, compressors, hoist, and pumps. At the Stockton Hill mine a vein of good ore is reported to have been encountered recently on the 265-ft. level, and a new mill is planned. W. R. Wook is superintendent at the Stockton Hill, and Hall Livingston is the owner of the Blue Eagle.

▶ The Arctic mine near Washington, Nevada County, has been acquired by L. F. Utter, of Los Angeles, who has a crew of ten men at work reconditioning the property in preparation for operating through the winter months.

▶ Extensive development work is to be started immediately at the La Honda property, near Quincy, Plumas County, acquired recently by C. C. Underhill, of Las Vegas, Nev., and associates. Considerable work has been done in the past by the former owners, J. W. McKay and W. I. Nelson. The mine is equipped with a small mill and improved mine plant, and adjoins the Edmonton property, a noted producer in pioneer days.

▶ Bulolo Dredging, Bulolo, New Guinea, reports a net profit for the year ended May 31 of $3,585,975, compared with $3,208,986 during the previous year. Working costs were 12.03c. a yard, including amortization and Government royalty. Ground dredged during the year was 11,197,000 cu.yd. averaging 5.92 grains (gold plus equivalent silver) per yard. Reserves are estimated at 202,000,000 cu.yd. as at May 31. Two further large dredges (Nos. 5 and 7) and a smaller one (No. 6) are under construction, and when these are in operation it is expected that costs will be reduced between 2c. and 3c. per cubic yard. Machinery and supplies totaling 4,277 tons were flown in from the coast during the year, making a total to date of 19,282 tons carried in by the company's airplanes.

Dorrco Doings in 1937

The year end business slump suggests that our "planned prosperity" may have overlooked some fundamental economic and psychological laws. One Treasury official is reported to have said "Business should take no risks" when the setting up of reserves for such risks as these was under discussion. I wonder if he ever had to meet a payroll.

While international standards seem widely disregarded and a pessimist could justify most gloomy forecasts, it must be remembered that at least 99% of the world's population goes on its way, on the whole, happily. Our globe's phenomenal shrinking from the standpoint of communication and travel distances, with California now overnight and Europe soon to be nearly as close, calls for reappraisement of business methods.

WESTPORT

The Westport Mill, our new laboratory and research plant, was opened the end of July with the gathering of staff from Europe to Japan, and of technologists and old friends of the company from a wide area. The wide scope of our work there impressed both groups as did also the additional facilities which have added so materially to our output.

CLASSIFICATION

Dorr FX Classifiers continue to increase grinding capacity or reduce grinding costs in closed circuit work from 25% to 45%.

One property, now completing an FX modernization, expects to repay the entire cost in 13½ months through anticipated savings of 36 per cent in grinding power and 44 per cent in steel consumption. They will grind the same tonnage to the same fineness, but will use only 5 of their 8 ball mills.

PULP AND PAPER

New use for pulp and paper products, together with increased industrial activity, caused a worldwide shortage a year ago. Dorr Continuous Recausticizing Systems have filled an important place in new Kraft mill construction in our South Atlantic States and in Scandinavia.

The ADKA Saveall, introduced by us from Sweden last year, is giving high recovery of fibre and filler from white water difficult to treat.

CEMENT GRINDING

The new Leeds, Alabama mill of Universal Atlas Cement Company, a U. S. Steel subsidiary, will have two 1200-ton, two-stage, closed circuit grinding units. Modern Dorr Classifiers will close primary circuits and Dorr Turret Bowls the secondaries.

COMPACT

Ten tons a day of $175 a ton flotation concentrates are being cyanided in California. One 5-compartment Dorr Combination Type Washing Thickener, 15′ in diameter and 23′ deep, gives preliminary thickening and four stages of Counter-Current Decantation with an actual recovery of over 99%.

SUGAR TECHNOLOGY

Our associates, Petree & Dorr, continue to demonstrate the increased advantages of Compound Clarification, especially in processing the newer types of sugar cane.

Our Continuous First Carbonation Process has now replaced batch methods in handling half the North American beet sugar output and continues to progress.

We are continuing research and development on newer methods which should make still further improvements in the processing end of the industry during the coming year.

INDUSTRIAL WASTES

Laboratory and semi-plant scale investigations in both chemical and biological treatment are broadening our knowledge in this active field. In England we are treating most successfully the waste wash liquors from an esparto mill using the soda process.

ENGINEERING

One not closely in contact with our work cannot realize the part our Engineering plays in a well operating plant. Our contributions lie in detailed design of equipment to make its individual performance the best and also to have it contribute most to related units. This has brought us into unit design and layout, as well as complete plant design in Central and South America, Europe and Japan.

It has given us a staff of skilled engineers who must see the process as a whole. It also explains why the man who must run the plant and the consulting engineer with general responsibility for it, want Dorr equipment and specify it in preference to equipment offered by others as "just as good."

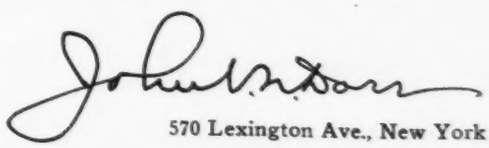
SANITATION

The year just ended saw the starting up of the 200 million gallons a day water purification plant for the City of Cincinnati, equipped with Dorrco Flocculators and 175′ Dorr Clarifiers ahead of filters, as well as the initial operation of the 180 M.G.D. sewage treatment plant for the City of New York on Ward's Island, where Dorr Clarifiers are provided for primary sedimentation of raw sewage.

Omnium D'Assainissement, our French associates in municipal sanitation, have recently received a contract for the initial 50 M.G.D. unit of the City of Paris sewage plant, which ultimately will have a capacity of 600 M.G.D. and treat the sewage from the entire city.

The year has seen for me constructional guidance at Westport, where the permanence of stone and concrete required great prevision; also organizational work in building that human structure that is the soul of a company and on which its progress depends.

Although not minimizing the present recession, those who survived the last know that tight belts and high courage will carry them through. To friends around the world, including those of our staff travel-bound in India and Australia, I send greetings.



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DORRCO

ARIZONA

Leases on Small Properties Multiply

Previous metal producers maintain steady output—Hillside Mines taken by new company

▶H. L. Williams, Box 1226, Prescott, president and general manager of the Hillside Mines, Inc., of Hillside, announces the leasing of the company's property to the newly formed Hillside Mining & Development Company. M. E. Rodgers, of Denver, Colo., heads the organization. Associated with him is Guy C. Riddell, of Rye, N. Y. The Hillside mine has been operating steadily, with a production of approximately 5,000 tons of ore per month. Over 100 men are employed. The property is equipped with a 200-ton flotation plant for the recovery of gold and silver.

▶Claude Wilkinson, of Kingman, operating the Bi-Metal mine, near Kingman, is continuing ore shipments to the Tom Reed mill, at Oatman, at the rate of about 3,000 tons monthly. Returns have been satisfactory and development work is disclosing a greater tonnage of ore reserves as the work progresses.

▶The Texas Camp mine, at Oatman, owned by Tex Ingram and under lease to Harry Wade and Bob Carter, is being developed on a 2-ft. vein of $50 ore. A recent shipment to the Tom Reed mill, at Oatman, substantiates the claim. The shaft is down 135 ft. and crosscuts have opened a considerable body of milling ore.

▶B. F. Koch, of Cleveland, Ohio, and James Simpson, of Phoenix, Ariz., have recently purchased the Julius group of claims, near Quartzsite, and are reported to be planning the construction of a mill at the property. They are now drifting to get under a shoot of ore previously developed.

▶The mill at the Cyclopic mine, situated in Gold Basin district, 60 miles north of Kingman, is operating steadily. E. H. Crabtree, of Chloride, Ariz., is general manager of the property.

▶Pioneer mine, at Oatman, has about 60 leasers at work, all of them producing gold ore that is sent to the Tom Reed mill. George Moser is manager of the property and resides at Oatman.

▶Jack McIvor is prosecuting a drilling project on the Martin-Adams property, 3 miles southwest of Kingman. The drilling will extend over an area of several thousand feet and will determine extension and value of ore developed near the surface.

▶The Seaboard Mining company, 146 West Adams St., Phoenix, has taken a lease and option on the Rio del Monte mines, in the Ellsworth district 4 miles south of Salome, Ariz. There are about twenty claims in the group, and work has already been started. The company is headed by O. K. Gilliam, 366 Bradbury Building, Los Angeles, Calif.

▶The Tombstone Extension mine, one and a half miles east of Tombstone, has been taken under lease by T. W. Tindell, a mine operator of Tombstone. He is working in the original discovery shaft and reports the opening of a good vein of ore. The mine is the property of the Tombstone Mining Company, headed by C. M. D'Autremont, of Tucson, and Harry Haselgren, of Tombstone. The property was located about ten years ago and has a record of considerable production.

▶The Tennessee-Schuykill mine, at Chloride, Mohave County, is continuing its shipments of lead and zinc concentrates at the rate of three carloads a week. A crew of men is cleaning out the 1,400-ft. level, and the 200-ft. winze from the 1,400 level will be unwatered. Known orebodies on the 1,600-ft. level will eventually be reached.

▶General Ores Reduction Company, at Chloride, is operating its custom mill at capacity. Recently additional flotation cells and a filter have been added to the mill equipment. About 30 tons of ore are being received daily from the Minnesota-Connor mine, which was recently taken over by the Minco Mines Corporation. C. A. Ferrin is general manager of the Ore Reduction company.

UTAH

Grand Central Mine Being Rehabilitated

Shaft retimbered to 2,300-ft. level and railroad spur will be extended to remove dump ore—Four old producers consolidate into a new company

▶At Monmouth, in the Tintic district, the American Smelting & Refining Company has retimbered the Grand Central mine shaft to the 2,300-ft. level. Track is being laid on intermediate levels, timbering replaced, and ore chutes are to be installed for the purpose of resuming ore production. A 2,300-ft. railroad spur is being extended to the Grand Central dump, and a tunnel, 6 x 7 ft., is being extended under the dump to connect with the 250-ft. level of the Grand Central shaft. Ore will be hoisted to the 200-ft. level and stored in chutes leading to the 250-ft. level. Ore is to be moved by electric cars to a trestle and dumped into railroad cars for shipment to the Garfield smelter of the A.S.& R. for use as a flux for the base ores from Bingham.

▶Four old Tintic companies—the Eureka Lilly, the Iron King Consolidated, the East Tintic Consolidated, and the Provo Mining—went out of existence on Jan. 1. Subsidiaries of the Tintic Standard Mining Company, they were consolidated into one company, the Eureka Lilly Consolidated Mining Company. The properties will be developed from the Tintic Standard and the Eureka Standard shafts. Officers of the new company are Ira D. Travis, president; James W. Wade, vice-president; L. H. Stohr, secretary, and M. D. Paine, treasurer. G. L. Becker is the fifth director. Offices are in the Walker Bank Building, Salt Lake City.

▶Rich high-grade ore has been struck by Lloyd W. Hoskins on his lease in the New Premier Consolidated property, 70 miles south of Wendover, in the Goshute Indian reservation.

▶Stockholders of the Bonanza Mining and the Frisco Lulu Mining Company, owning ground in the San Francisco district, Beaver County, have voted to merge their properties under one ownership held by the San Francisco Mines, Inc.

▶Ore has been opened on the 900- and the 1,600-ft. levels of the Moscow Silver Mining Company's property near Milford. A shipment from the lower level netted $14.53 a ton.

▶The United States Smelting, Refining & Mining Company has completed enlargement of the shaft leading from the 1,100- to the 1,500-ft. level of the Bingham Metals property at Bingham, held on a ten-year lease. A drift on the 1,500 level connecting with the Niagara tunnel has cut several fissures, which are being prospected.

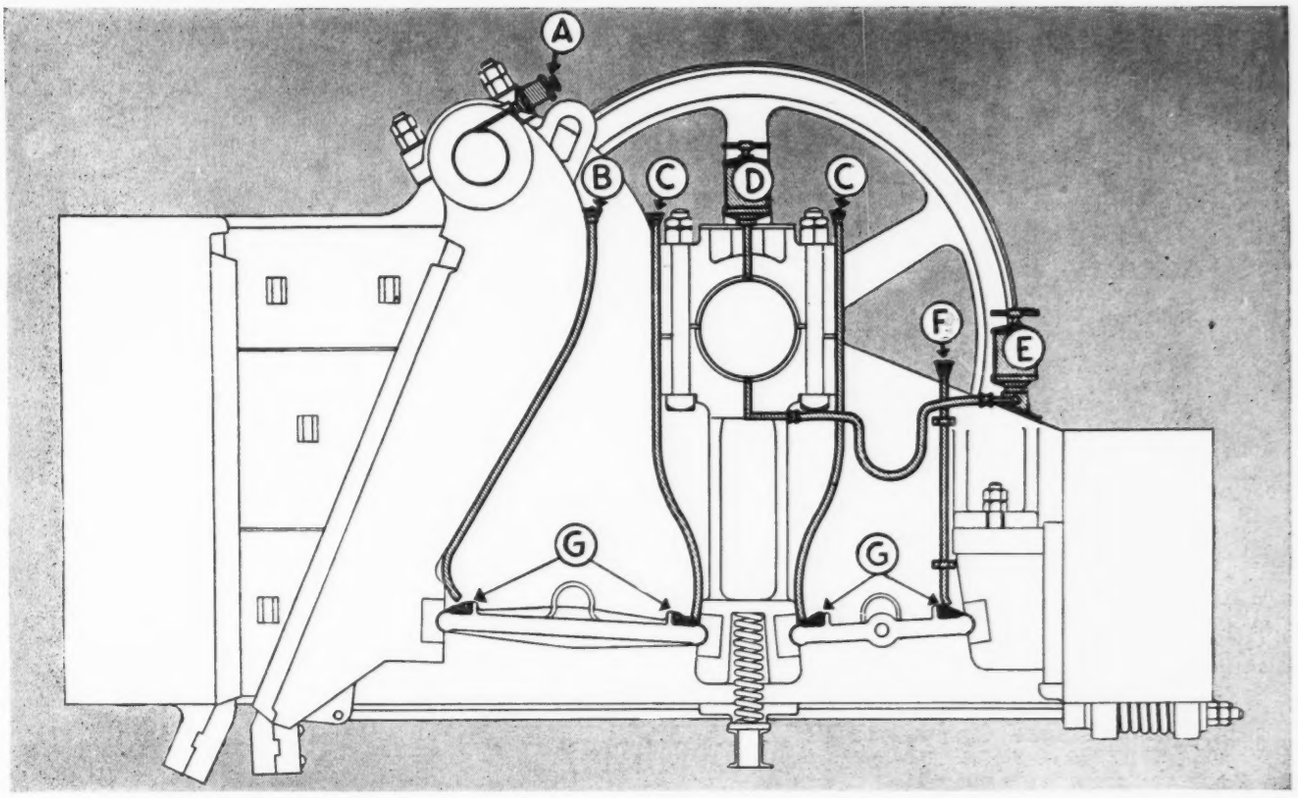
▶The Eureka Standard and the Tintic Standard Mining Company paid dividends of 5c. and 25c. a share respectively on Dec. 23. Eureka Standard has paid 11c. a share, or $164,954.90, during the year, and Tintic Standard, 83c. a share, or $957,251.46, for the same period. Silver King Coalition Mines paid a dividend of 25c. a share, totaling $305,116.75, on Jan. 3.

▶Suit will be filed against the Utah Copper Company in the United States Supreme Court by the Utah State Tax Commission to clarify the Utah statutes relating to the taxing of net proceeds and metal held in inventory. Recently, the Circuit Court of Appeals upheld the copper company's interpretation of the law and reduced its taxes from $251,509.90 charged by the Tax Commission for 1935 to $85,208.01. The Tax Commission would assess the company on the basis of net proceeds of all sales during the year, whether or not part of the sales were derived from copper made in other years. The Copper company claims that blister copper held over from previous years is money or its equivadent, and proceeds from its sales cannot be taxed as part of the annual net proceeds.

▶Two International Smelting Company subsidiaries declared dividends that were paid on Dec. 23.

Mountain City Copper Company, operating in Elko County, Nev., paid a dividend of 25c. a share, totaling $592,856.75.

Walker Mining Company paid 5c. a share, totaling $87,465.40. The Walker mine is situated in Plumas County, Calif. Recently, these companies have lowered their copper output due to the business recession, which has curtailed copper demand.



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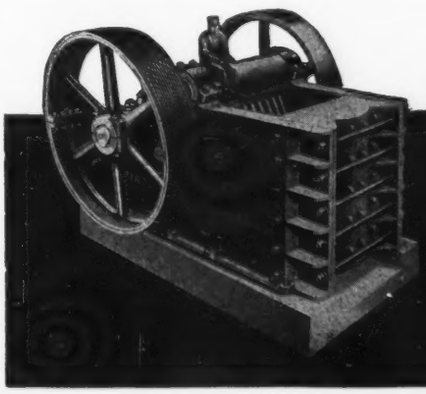
G Pack Recesses in Toggles with a Waste Pad or Wool Yarn and Keep Soaked with Oil Through Pipes B-C-F.
H Eccentric Shaft Frame Bearing Lubricating Grease Cups. (Not shown in diagram.)



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COLORADO

Ore Shipments From Idaho Springs Reach High Level

Steady production maintained by numerous small operators—Tunnel at Central City may be extended by North American Mining Company

▶ The Humboldt Consolidated Mining Company, in the Idaho Springs district, has removed the old Jackson mill and is now utilizing about fifteen acres for a tailings pond. The mills in this district are having some difficulty in finding sufficient space for tailings. The change in the highway to the south of Clear Creek has given more space for tailings from the Alma-Lincoln Mining Company.

▶ The North American Company, with properties in Clear Creek, Gilpin, Boulder, and San Juan counties, has reorganized, and plans to complete its Central tunnel project in the Idaho Springs district. Consolidation with the Gilpin County holdings will provide a convenient ore outlet through the tunnel for the Belmon-Dove's Nest group and the Pewabic group.

▶ The highest tonnage of ore from the Idaho Springs district shipped in 25 years was made over the C. & S. railway during September. This tells the best story of the increased interest in mining in Colorado since the World War.

▶ The Pulaski mine, in the "Loop area," in the Georgetown district, was reopened in November by George Leece and associates. This mine has a fair tonnage of high-grade shipping ore. With more development work, permitting decreased cost in operation, steady ore shipments are expected.

▶ Joe Kotich has leased the Exchange lode, located near the summit of Mount Leavensworth. This property lies in approximately the same mineral belt as the Pulaski and Rio Grande-Zeda.

▶ Steve Herrin is operating the Wheatland mine, which is in the Trail Run district near Idaho Springs. This is considered an extension of the Donaldson vein, which is about 30 in. wide, which has an early shipment record of approximately seven million dollars.

▶ Margaret Mines, Inc., have started operations on Seaton Mountain north of Idaho Springs. They have purchased virgin ground adjoining the West Santa Fe Mines and in the same mineral belt as the Sun, Moon, and Gem mines. The company is retimbering the 350-ft. shaft and constructing new buildings. The shaft will be sunk another 150 ft. Directly west of this property, Bill Taylor is operating the West Santa Fe mine.

▶ A steady shipment of eight cars weekly from the International Gold Producers, operating the Logan property of the Stratton Estate in the Cripple Creek district, has reflected steady operation of this property and continued development work. From the fourth level of the Specimen, another property of the Stratton Estate, the Lone Eagle Mining Company is shipping one car of ore weekly.

▶ The San Juan Milling & Refining Company, at Mancos, is constructing a 150-ton mill estimated to cost $150,000. J. A. Pratt is manager. This property will greatly help to stimulate mining in this territory.

▶ Remodeling of mill buildings and installation of new equipment of the new tungsten mill at the Yukon mine, operated by the Gold Hub Mines Company, have been completed. John Cooper is manager at Silverton.

▶ The Golden Cycle mill, at Colorado Springs, has been improved by the recent installation of new steel, 4-ft. Symons cone crushers, and by increasing the coal-bin capacity to 300 tons. During the 30 years of operation, the Golden Cycle mill has treated about 9,000,000 tons of ore.

MONTANA

Basin Montana Tunnel Co. Stops Work at Gray Eagle

Low prices for base metals retard development programs of many operators—Winter weather closes McLaren Gold Mines

▶ Uncertainty created by the sharp drop in metal prices has influenced operators to consider carefully the extent of their development programs, and if the situation in copper fails to improve it is believed producers may be forced to take even more drastic views on curtailment.

▶ The State Board of Equalization reports that metal mines tax collections for the current year totaled $253,169.11, compared to $180,799 in 1936. Income from this source reached a low of $36,000 in 1933 and a high of $555,000 in 1929.

▶ Operations at the Grey Eagle unit of the Basin Montana Tunnel Company have been stopped, although production at the Comet mine of the company has not been affected. The properties produce complex lead, zinc, silver, and gold ores, which are concentrated at the mill at Comet. Frank McPhearson is in charge.

▶ Among placer operations which are expected to be started or resumed in the spring are the Wisconsin Creek project and the Alder Gulch dragline operations, both in Madison County. J. W. Goldsbury, S. W. Reedy, and Minneapolis associates are reported to have engaged H. W. Bogie, formerly superintendent for Winston Brothers, to take charge of installation of washing equipment on Wisconsin Creek. In reference to the Humphrey Brothers' operations on Alder Gulch, resumption of work will probably depend upon release of certain equipment now in use at Clancy.

▶ Crude-ore production from the property of the McLaren Gold Mines Company, situated near the summit of Daisy Pass, 4 miles north of Cooke, will not be continued during the winter months, owing to adverse weather conditions. The mill, at Cooke City, will continue operation on reserves accumulated in excess of current requirements during the summer working season.

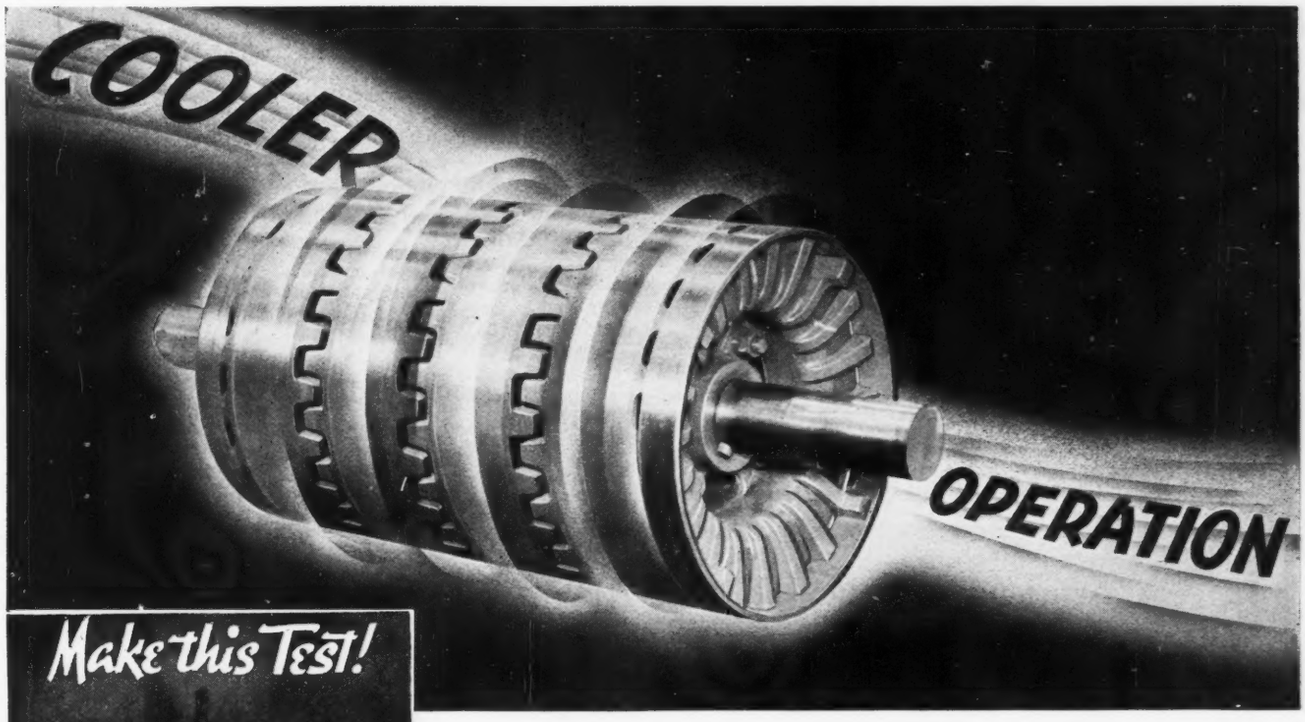
IDAHO

Mining Men Take Over Silver-Lead Property

Rainbow Mining & Milling Company sells holdings in Evolution district—Bonus given to many workers at Christmas time

▶ No. One Mine, a silver-lead-zinc-copper property of the Rainbow Mining & Milling Company in the silver area of the Coeur d'Alene, has been bought by Stanly A. Easton, president of the Bunker Hill & Sullivan mining company, and associates for $250,000, according to George Austin, president of the Rainbow. The transaction was closed at Coeur d'Alene when a substantial down payment was made. The property is one of the largest in the silver belt, following the Callahan and the Sunshine Consolidated. The No. One Mine has 5,845 ft. of development, and 500 ft. of diamond drilling has been done on the property. Three veins were cut by the main tunnel. Associated with Mr. Easton in the enterprise are James F. McCarthy, president of Hecla Mining Company; Fred Searls, a vice-president of Newmont Mining Company; Frank Eichelberger, president of Sunshine Consolidated.

▶ Pay checks, bonuses, turkeys for Christmas, and other good things were handed out to 5,000 miners, mill men, and smelter men in the Coeur d'Alenes during Christmas week. Pay days were advanced in order to come in ahead of the Christmas holiday. The Coeur d'Alenes pay a higher wage scale than any other mining district in the nation. The bonus, established several years ago upon a sliding scale depending upon the price for lead, is still in effect as set last spring, when the price of the metal was above 7c. Wages were not lowered as the price dropped back to its present quotation of 4½c. per pound. At the Sunshine mine more than 500 employees received an additional 5 per cent bonus, totaling $43,000, based on their earnings for the past year, some of the miners receiving up to $150 in extra checks. Last year the Sunshine board paid its men a 3 per cent bonus and last summer stated the amount this year would be on a 5 per cent basis. Late reports advise pay cuts of 50c., per shift were made, effective Jan. 1, at many mines in the Coeur d'Alene district, due to the sustained drop in base metal prices.



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▶IDAHO

▶Operations at the Bear Top lead-silver mine of the Merger Mines Corporation, in the Murray district, are progressing favorably, according to Morris Pearson, manager. Some raises were recently completed from the No. 3 tunnel in the orebody.

▶Activity by the Bobby Anderson Group Mining Company in the Pine Creek section is expected soon, according to Ben F. Miles and associates, who have become associated with the project and will take over the management. At a meeting of the directors in Kellogg an assessment of 3 mills per share was levied, proceeds from which will be used to clear up accounts and get the mine ready for operation.

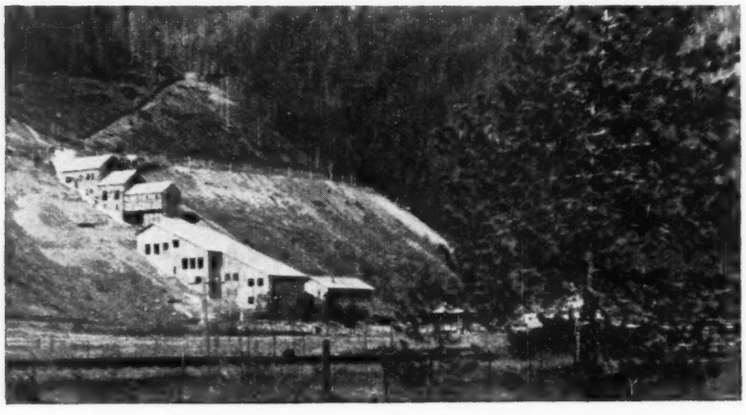
▶The shaft at the Metropolitan property being sunk from the 400-ft. level to the 600, encountered at 435 ft. ore containing gray copper and galena.

▶Work has started at the Atlas property, in the Mullan district, under the direction of President-Manager W. Earl Greenough, of Mullan. Considerable preliminary work is to be done on the Carbonate Hill group, where a raise of 150 ft. will be driven to connect with the shaft.

▶A total dividend payment of $81,573 from the three Day properties, Dayrock, Tamarack, and Sherman, was announced during December. Of this sum the Sherman will pay 1.2c. per share on the issued capital of 3,675,000 shares, totaling $44,100. The Dayrock company will disburse to its stockholders at the rate of 1c. per share on its issued 1,747,300 shares. This payment will amount to $17,473. Tamarack & Custer will present its owners with two-fifths of a cent per share. The company has 5,000,000 shares outstanding, making the disbursement $20,000.

▶The old-time Parker mine, in Lemhi County, one of Idaho's early-day producers, after many years of idleness is expected to be operating soon. A statement issued by K. L. Stoker, company vice-president, of Idaho Falls, indicates the company is now prepared to spend $65,000 for installation of a 50-ton mill and other equipment.

▶Miners are having a tough time with the weather in Valley County. After a three-day journey, traveling 30 miles, plowing snow and breaking roads, a crew from the Pearce Metal mine finally arrived in Cascade. Operators of the Lucky Lad mine, in the Pistol Creek section of Valley County, have found it necessary to use tractors to pull their trucks loaded with winter supplies from Scott valley to the mines.



Polaris Mining Company, a producer of copper, lead, and silver ore, near Wallace, Idaho, shipped the first concentrates from its new 200-ton mill on June 15, 1937, and paid its first dividend on November 29, 1937

▶An interesting table prepared by the county auditor, Harry A. Rogers, of Wallace, shows the importance of silver mining in Shoshone County, Idaho, the largest silver producing county in the United States:

Total ounces of silver produced in past 12 months	19,344,686	
Total value, at 77c. per oz.	$14,785,408.22	
Total number of men employed by mining industry past 12 months.....		4,964
Total payroll for above, during past 12 months..	$8,609,085.34	
Other business enterprises created and entirely dependent upon mines.....		396
Total number of persons employed by above, past 12 months		1,479
Total payroll for above during past 12 months..	$2,307,240.00	
Total number of persons actually dependent on mining industry		19,996
Total annual wages involved	$10,916,325.34	
Total taxes paid by mining companies, for support of state and local government, as shown by 1937 county tax roll.....	$372,331.88	
Of total taxes paid in Shoshone County, the mining industry pays.....		48½%
The value of silver produced in the past 12 months exceeded the total wages paid for labor employed in all lines of business and industry in Shoshone County by the sum of		$3,869,000.00

▶Directors of the Hecla Mining Company, meeting in Milwaukee on Dec. 2, declared a dividend of 25c. per share, totaling $250,000 on the issued capital of 1,000,000 shares. With this disbursement the Hecla pays its stockholders $950,000 for the current year and brings the grand total of dividends paid by the corporation up to $22,455,000.

▶The reported discovery of a method of treating the ore in the Salmon River district contained in the shales, schist, and monozite of that area has aroused interest in this district, where a number of persons are interested in concerns with holdings along the Salmon between Riggins and Pollock. According to a statement by Ben Gillenbeck, of Tacoma, Wash., president of the American Rand Mining Company, his metallurgists, after five years of research, have shown that gold and platinum in the veins can be recovered. The gold content, Mr. Gillenbeck states, runs from $12 to $35 per ton and the platinum about $50.

MICHIGAN

Isle Royale Hopes for Production in March

Objective is copper output around 750,000 lb. monthly—Aerial survey suspended until spring

▶A resolution authorizing the sale of the assets and property of the Isle Royale Copper Company, a New Jersey corporation, to the Isle Royale Copper Company, a Michigan corporation, was endorsed by a large vote at a special meeting of the stockholders held on Dec. 14 at the company's principal office in Jersey City, N. J. The vote approving the reorganization was considerably in excess of the necessary two-thirds' majority. Reorganization, which was favored by the board of directors, was necessary to permit the calling of an assessment to complete the rehabilitation of the mine. If the reorganization had not been voted by the stockholders, it would have been necessary to abandon the project at this uncompleted stage. Funds derived from the reorganization assessments are expected to give the company from $75,000 to $150,000 of working capital, which is believed to be adequate to get the company back to a regular production basis of 750,000 lb. of copper per month. It is hoped to start producing in March and to reach a 750,000-lb. production in June. In the vicinity of Nos. 4 and 5 shafts, it is estimated that 1,000,000 tons of ore is ready for mining below the 25th level, 200,000 tons in a pillar on the 17th level, and 200,000 tons more in shaft pillars. From this it is estimated that 32,000,000 lb. of copper can be produced. The Isle Royale Copper Company was incorporated in 1899 and production of copper was started in 1901. Since that time until the end of 1925, a total of 10,469,751 tons of ore was produced, yielding a total of 171,718,963

lb. of copper, or 16.39 lb. per ton. In the period between 1926 and 1931, 2,731,939 tons of ore was treated, yielding a total of 62,184,025 lb. of copper, or 22.76 lb. per ton. The record shows a substantial improvement in the recovery of copper per ton of ore in recent years.

▶ After a futile wait of several weeks for favorable weather, heavy snow has forced cessation of aerial mapping activity in the Michigan copper district until spring. Although several flights were made, a succession of cloudy days prevented the taking of a single satisfactory picture. Considerable work was accomplished, however, by a ground control crew in making surveys to locate important landmarks which will show on the aërial map mosaics to be produced after the needed photographs are taken of the territory from the air. The maps will be helpful in geological exploration; in highway and other projects; in making base maps; and to prospectors, hunters, and others. The Federal Government and State divide the cost of mapping operations, the Michigan Legislature having provided $25,000 for the purpose.

TRI-STATE

Low Zinc Price Brings Wage Cuts and Lay-offs

Curtailment in production necessary as demand for metal fades—St. Louis Smelting & Refining Company installs new sampling equipment

▶ There were 33 mine mills and eleven tailings re-treatment mills operating during the middle of December with part of these operating on a part-time schedule. Between 2,000 and 2,500 men have been dropped from the payrolls since early in September, when approximately 6,000 men were working. Wages have declined $1.50 per day during this period. Machine men (miners) now are receiving $4.05 per eight-hour day and unskilled labor underground receives $3.30 per day. It is not expected that a further reduction will occur unless concentrate prices recede drastically, for most of the operations at this time are those of the major companies and it is expected that they will continue to operate in order to keep their organizations together. Production has been cut from a high of 10,000 tons of zinc concentrates per week to around 7,500 tons. This was further reduced during the last two weeks of December by the holiday shutdowns. Most of the companies shut down over the Christmas week-end, but several companies were down for approximately ten days, or until Jan. 3.

▶ The St. Louis Smelting & Refining Company will close its Ballard (No. 8) mill for approximately ten days during the holiday season so as to install sampling equipment in the mill to take care of the mine ore from three shafts on other fee lands, according to H. H. Utley, company manager.

▶ Eagle-Picher Mining & Smelting Company is down 388 ft. with its deep shaft on the Garrett land. At this depth the company encountered a strong flow of water under 90 lb. pressure. The drill holes were plugged and cement was forced into the crevices under high pressure. Sinking will be discontinued until the flow of water has been shut off.

IRON COUNTRY

Ore Shipments in 1937 Totaled 62,598,836 Tons

This compares with 44,822,023 tons in 1936—Tractors, large auto trucks, and belt conveyors finding wider application in iron mines

▶ The 1937 season of iron ore shipments was completed on Nov. 25 when the Steamer "Hennepin," of the Cleveland-Cliffs Iron Company, sailed with the last cargo of ore bound for Cleveland. The total shipments from the Lake Superior district totaled 62,598,836 gross tons. This compares with 44,822,023 in 1936 and 65,204,600 in 1929. The slump in the steel industry curtailed the original estimates; otherwise the 1937 season may have reached the peak recorded in 1929. Business in general is rather quiet on the Iron Range, although several small jobs are under way. Pickands, Mather & Company have a large stripping program at the Scranton mine, at Hibbing, Minn., and expect to continue this work all winter. Stripping is also in progress at the Danube mine, at Bovey, Minn.

▶ Stripping at Butler Brothers is causing widespread interest. Use of caterpillar tractors and 15-ton trucks is a departure from old methods. The trucks travel about 15 miles per hour on a 10 per cent grade. Many believe that a property previously considered unprofitable can now be operated successfully by the use of these trucks on steep grades. The method of open-pit mining has been entirely revolutionized, and it is expected all pits will eventually come to use operating equipment consisting of belt conveyors, trucks, and tractor systems.

▶ The Wisconsin Steel Company is operating the Bruce mine, at Chisholm, Minn.; the Agnew, at Hibbing; and the Sargent mine, at Keewatin. These are all underground mines. The Republic Steel Corporation is operating the Alexandria mine, at Chisholm, another underground mine, and the Oliver Iron Mining Company is operating the Spruce, at Eveleth, Minn.; the Godfrey at Hibbing, and also the Morris, at Hibbing.

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NEWS FROM Washington

By Special Correspondent

CONGRESSIONAL ENACTMENTS during the special session were negligible, but real progress was made in the many negotiations which necessarily precede the passage of any important bills. There is, therefore, some hope that a few items of important constructive legislation can pass early in the regular session, convening on Jan. 3.

Conflict between Congressional business-aid decisions and executive-department reform measures has not been ended. But there is no doubt that the recession will suppress the Reformers long enough to give Congress a fair chance for tax revision, and for a few other items of January and February business that are much needed. This does not represent an abandonment by the President of any fundamental principles. It represents, rather, a realistic acceptance of declining-business facts, as they create the necessity for postponement of the New Deal program.

Military Strategics

CONGRESS is being urged to give prompt attention to the bill (H.R. 1608) which provides that the Secretary of War may acquire reserve stocks of manganese ore, chrome ore, tungsten ore, and pig tin sufficient for the national defense. The House Committee on Military Affairs says about this bill:

"It is advisable that this legislation be enacted at this time since it is evident that its provisions can be carried out only in time of peace. Furthermore the provisions of the Neutrality Act add urgency to this legislation since, even during a major war to which this Nation were not a party, the application of the embargoes provided in the Neutrality Act might result in retaliatory action on the part of the nations involved with resulting hardship and diplomatic friction to the United States."

The War Department favors the bill, and would like to proceed with this acquisition of mineral reserves authorized "to be made where possible through credit against foreign war debts and through exchange of agricultural commodities owned by the Federal Government, stocks so acquired to constitute a national reserve and to be used only during emergency upon order of the Secretary of War."

Seldom has the War Department been more frank on a strategic material subject than in the following portion of its letter to Congress:

"In general, the normal peacetime stocks of strategic materials maintained within the United States are adequate for purely military war needs, should they be used in a national emergency exclusively for such. The War Department is of the opinion, however, that the requirements of industry to meet essential civilian needs in war must be given equal consideration with those for the armed forces. To this end, all recommendations made by the Department for establishment of war reserves stocks have included civilian essential requirements as well as those for purely military purposes."

Silver at 64.64c per Ounce

PRESIDENT ROOSEVELT'S proclamation establishing the price of domestic newly mined silver at 64.64c. per ounce from Jan. 1, 1938, to Dec. 31, 1938, is as follows:

Whereas, by proclamation of the twenty-first day of December, 1933, as modified by proclamations of the ninth day of August, 1934, and the tenth and twenty-fourth days of April, 1935, the United States coinage mints are directed to receive for coinage and addition to the monetary stocks of the United States silver mined subsequent to Dec. 21, 1933, from natural deposits in the United States or any place subject to the jurisdiction thereof; and,

Whereas, such proclamation as so modified states in part that:

"This proclamation shall remain in force and effect until the thirty-first day of December, 1937, unless repealed or modified by Act of Congress or by subsequent proclamation." And that,

"Notice is hereby given that I reserve the right by virtue of the authority vested in me to revoke or modify this proclamation as the interest of the United States may seem to require."

Now, therefore, finding that the interests of the United States require further modification of said proclamation of the twenty-first day of December, 1933, as so modified; by virtue of the power in me vested by the Act of Congress cited in said proclamation, and other legislation designated for national recovery, and by virtue of all other authority in me vested:

I, Franklin D. Roosevelt, President of the United States of America, do hereby further modify the said proclamation of the twenty-first day of December, 1933, so that the same shall remain in force and effect until the 31st day of December, 1938, and so that the amount of deduction for seigniorage, brassage, coinage and other mint charges from the monetary value of silver delivered thereunder which has been mined on or after January 1, 1938, shall be fifty per cent of such monetary value, and I do proclaim and direct that, with respect to all silver received by a United States coinage mint under the provisions of the said proclamation of the twenty-first day of December, 1933, which such mint, subject to regulations prescribed hereunder by the Scretary of the Treasury, is satisfied has been mined on or after January 1, 1938, from natural deposits in the United States or any place subject to the jurisdiction thereof, the deduction for seigniorage and services performed by the government shall be fifty per cent and there shall be returned therefor, in standard silver dollars, silver certificates, or any other coin or currency of the United States, the monetary value of the silver so received (that is, $1.2929 plus, per fine ounce), less such deduction of fifty per cent, and that the said proclamation of the twenty-first day of December, 1933, as heretofore and hereby modified shall remain in force and effect until the 31st day of December, 1938, unless repealed or further modified by Act of Congress or by subsequent proclamation.

Notice is hereby given that I reserve the right by virtue of the Authority vested in me to revoke or modify this proclamation as the interests of the United States may seem to require.

In witness whereof, I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the City of Washington this 30th day of December, in the year of Our Lord nineteen hundred and thirty-seven, and of the Independence of the United States of America the one hundred and sixty-second.

FRANKLIN D. ROOSEVELT.

(Signed)
By the President:
(Signed) Cordell Hull,
Secretary of State.

Secretary Morgenthau announced on Dec. 30 that the United States will purchase the Canadian silver surplus throughout January at unchanged prices. Also, he disclosed, the silver purchase arrangements with Mexico and Canada had been on a month-to-month basis under the present Administration.

Business Trends

WASHINGTON KNOWS that a serious recession in business demands official attention. Even those who argue that Washington reforms have not been any factor in causing slackening of industry are agreed that every available influence of the Government should be applied to aid industry in reversing recent trends. But there are as many theories as to what to do, and what not to do, as there are groups offering opinion.

Among the best-informed economic advisers of officialdom there is no consensus of opinion regarding cause or remedy, but there is considerable comfort-taking in the violence of decline, for, as one interpreter says, such a quick drop does less damage than the attrition of a long-continued decline. Rebound from bottom when or if it has been reached ought to be fairly prompt, according to this theory, rather persuasively presented by men who are realistic economists, not partisan interpreters.

There is a general feeling in Washington that this recession is a commodity phenomenon, not a banking or fiscal one. Inventories of heavy industrial goods got too large. Advance buying in anticipation of shortage or price rises gave an over-stock which became apparent in industry during the spring and summer of 1937. As quick as the reversal of the stock market and the slowing down of new orders were noted, the holders of these inventories began to reduce their takings of goods. The effect was cumulative, and self-aggravating. Only thus can the conservative economists explain what has been noted in 1937.

Depending on this theory it is necessary to forecast a renewed buying to replace depleted inventories as soon as the year-end reports have been made. As a matter of fact ,the conservative economists who reason as outlined in the foregoing, are of the opinion that the lowest business conditions have been reached or passed. They point to the up-turn in price of iron and steel scrap as one of the best evidences of this fact. They state that general reports from business indicate a need for renewed buying of producers' goods soon after the New Year.

Despite these interpretations and optimistic forecasts, the Administration unanimously expects revision of taxes, and perhaps other important legislative or executive actions, to insure a reversal of the price and employment spiral which has been so strongly downward for some months. Foreign buying, especially by England and France, will continue to aid also, officials believe. And everybody is whistling by the graveyard of possible "panic psychology" among business men. It is generally believed

INSURE LOWEST MILLING COSTS

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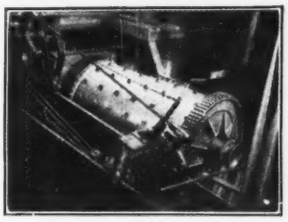
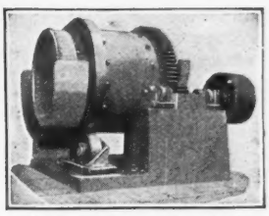
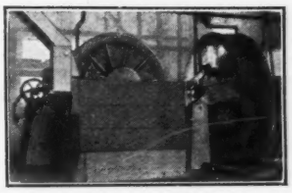


Rib-cone Mill and Rake Classifier.



Rib-cone Screening Mill 70 Sizes—2 to 500 Tons.



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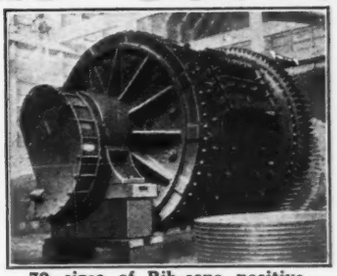

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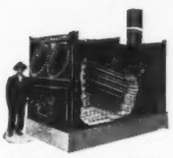

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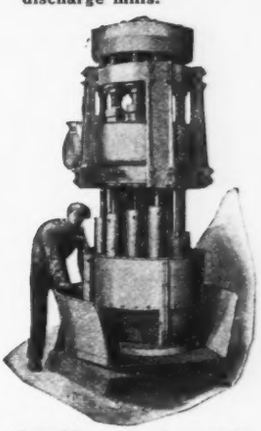

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that there is yet no such disturbance of executive thinking as to place new undue burdens on business.

Nationalizing Mines

THERE is a great deal of talk about Washington regarding new factors compelling government ownership of this and that. The fiscal plight of the railroads has, of course, set off most of the fireworks. But this thinking extends through public utilities to the resource industries. And the Reformers seem to think that "this is a logical time at which the Government should recapture the national resources for the benefit of the public." Extremist views like this will not prevail, but the reasoning which goes along with them is significant. Foreign experiences are frequently cited as evidence of the general trend. The nationalization of coal lands by Great Britain is taken to mean that the United States may not be too far behind in this plan, not only with respect to fuel, but also with respect to metals and nonmetallics. Reclaiming of mineral rights by Mexico (see *E&MJ*; December, page 72) and by Brazil are also frequently mentioned. National planners are, of course, anything but discouraged by these trends.

Some even think that the real significance of the 7 T.V.A.'s, as now proposed by the President, is resource recapture rather than power planning. The President's own words in his Nov. 15 message to Congress give psuedo credibility to that idea. He said: ". . . For this purpose of conservation and development of our natural resources, I recommended that the country be devided into seven great regions into which Nature divided those resources—that in such regions local authorities be set up to arrange projects into some kind of comprehensive and continuing plan for the entire region—and that only after such consideration should regional projects be submitted to the Executive and to the Congress for inclusion in a national development program of such size as the budget of the year will permit."

Also, one hears about Washington sharp criticism of the copper industry, among others, for its "wild fluctuation of price." Some well-informed officials say that if the industry would only aid in gathering and publishing at frequent intervals the full facts regarding production *and stocks*, there would not need to be as much of this "feast or famine" policy in copper. Such critics claim that capital investment in this industry would be more advantageously rewarded by a uniform smaller-than-peak price and profit activity. All of this, they opine, would follow if *both* the producers and users of copper knew every month just how much copper had been produced, and just how much remained in stock in the hands of *all* interested groups. These arguments for statistical guidance and uniformity in activity of the non-ferrous metal industries are presented as a defense of these industries against nationalization. In view of the previous activities of those who so argue, it does not appear that this is merely an anti-industry wolf in Little Red Riding Hood's robe of pretended service.

STRATEGIC MINERALS

CONGRESS states in report No. 1541 that accompanies H.R. 1608 the problem of acquiring a supply of certain commodities essential to this country in time of emergency. The following four strategic minerals and their recommended stockpiles in that report are as follows:

MANGANESE ORE—*The principal use of manganese is in the manufacture of steel. It is impossible to produce sound steel without high-grade manganese ore. Other uses are in dry batteries, in paint and varnish, and in fertilizer. The principal sources are Russia, Africa, Brazil, and India. Small quantities of ferro-grade ore are produced in this country and in Cuba. Studies indicate that under stimulus of war, domestic production might be increased to supply 30 per cent of the nation's requirements.*

Stockpile recommended,
554,000 long tons

CHROME ORE—*Principal use of chromium is in the manufacture of high-grade alloy and corrosion-resisting steels. Other uses are in refractories, brick, and cement, and in the chemical industry for electroplating, dyeing, and tanning. Sources are South Africa, Turkey, India, and New Caledonia. Domestic stocks are limited and production has averaged only 500 tons per year. Domestic production in war is estimated at not more than 25 per cent of requirements.*

Stockpile recommended,
250,000 short tons

TUNGSTEN ORE—*Tungsten is used principally in the steel industry in producing high-speed tool steel. The mass production required in war makes tool steel for high-speed machining of metals vital. Sources are China, Burma, and Bolivia. Domestic production in war can be increased to supply approximately 25 per cent of requirements.*

Stockpile recommended,
3,350 short tons

TIN—*Principal use is in tin plate for food containers. It is also used in bearings, for solder, and in the making of bronze and tin foil. Sources are the Straits Settlements of Malaya, the United Kingdom, and Bolivia. There is no domestic production of tin, although approximately 30 per cent of requirements may be obtained from secondary sources, including detinning.*

Stockpile recommended,
85,000 short tons

Profits Taxes

A CHANGED SYSTEM of calculating Federal taxes on profits can be expected soon, probably about the end of February. But the total tax burden which Uncle Sam will place on corporation and individual profits should not be expected to be any less next year than last, measured in over-all percentage. The Treasury must be safeguarded against declining income, is the demand of the President. Congress is almost willing to go along on this theory even though it sincerely and persistently intends to change the form of both capital-gains taxes and corporation undistributed-profit taxes.

During the Holiday recess between the special and the regular sessions of Congress it seems in prospect almost certain that capital-gains taxes are to be greatly reduced in percentage, and that such income will be treated as a separate item, not subject to high surtaxes in the returns to be made after next March. But no one expects this relief to apply to gains of 1937.

Congress probably will retain the principle of taxing undistributed earnings at a higher rate than those earnings paid out promptly as dividends. But the difference in the tax rates will be much smaller. As the special session adjourned it appeared more likely that the House subcommittee plan (Vinson Plan) would prevail. The President has indicated his willingness to go along on that general idea. Reduced to its simplest terms, this scheme of corporation profit taxing would be as follows:

The net earnings of a company would be taxed at the rate of 16 per cent if all distributed as dividends, or at the rate of 20 per cent if all were retained by the company. If part were held and part distributed some intermediate rate between 16 and 20 per cent would apply. All of this set of income taxes would, however, *not* apply to the first $25,000 of earnings per year for any company. This first unit of net earnings would bear a much lower rate of taxation, between 12 and 15 per cent probably; and there would be no extra burden on this part of the earnings, even though it were all retained by the company.

It is hoped by its proponents that such a plan would relieve some enterprises of those difficulties claimed under the old tax plan. It is also confidently expected that the scheme would encourage more use of earnings for expansion and betterment of enterprises, with consequent reemployment and stimulus to the heavy-goods industries. There seems to be no doubt that this general scheme can be counted on by business for whatever benefit will accrue. But these changes will not apply to earnings of last year—only to the earnings of 1938 and following years.

It is pointed out very frequently by those who favor such changes in the corporate-income tax and in capital-gains tax that industry will still have to pay about the same total bill. In fact, many of the larger units of industry are expected to pay a slightly higher average rate on their earnings under the new system. Those concerns which have distributed all their earnings certainly will be more heavily burdened under the new plan.

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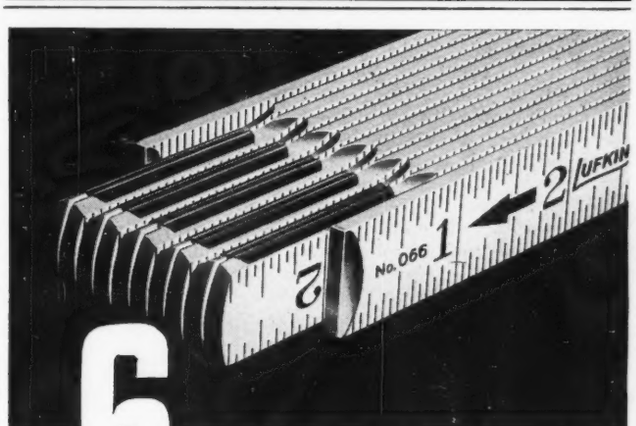

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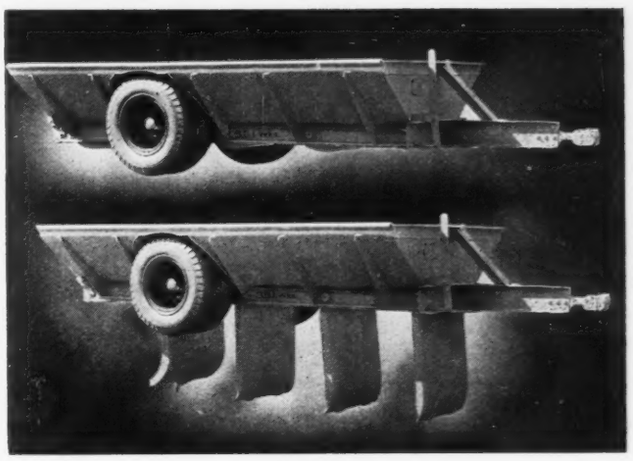

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CHRONOLOGY OF NEW DEAL SILVER LEGISLATION

• 1933 •

May 12, 1933 . . . Congress passes Thomas amendment to farm relief bill (1) authorizing the President by proclamation to fix the weight of the silver dollar at a definite fixed ratio to the gold dollar; (2) providing for unlimited coinage of gold and silver at the fixed ratio, (3) authorizing the President to accept silver at a price not in excess of 50¢. per ounce in payment of debts for foreign governments to the United States.

July 22, 1933 . . . Eight governments in the World Economic Conference, London, agree, subject to ratification, to restrict sale of silver and increase monetary uses for four years beginning Jan. 1, 1934. India, Spain, and China undertake to sell silver; Australia, Canada, United States, Mexico, and Peru to buy.

Dec. 21, 1933 . . . International agreement ratified by executive order of President Roosevelt. Provides for Treasury purchase of about 25,000,000 oz. per year for four years. Proclamation sets the price of newly mined domestic silver at 64½¢. per ounce.

Jan. 30, 1934 . . . Monetary bill approved with Pittman amendment for expanding use of silver in currency.

• 1934 •

June 19, 1934 . . . President signs Silver Purchase Act providing for purchase of silver by the Treasury up to one-fourth of the value of total monetary metal stocks.

June 28, 1934 . . . Treasury places embargo on silver exports except under license.

August 9, 1934 . . . Nationalization of silver by presidential proclamation at 50.01¢. per ounce, to effectuate policy of Silver Purchase Act.

• 1935 •

April 10, 1935 . . . Price of newly mined domestic silver set at 71.11¢. per ounce by presidential proclamation.

April 24, 1935 . . . Price of newly mined domestic silver set at 77.57¢. per ounce by presidential proclamation.

• 1937 •

Dec. 31, 1937 . . . Price of newly mined domestic silver set at 64.64¢. per ounce by presidential proclamation. Expires December 31, 1938.

American Mining Congress Meets In Annual Session

Resolutions adopted seek immediate repeal of the undistributed earnings tax and modification of the capital gains and losses tax

THE 40th ANNUAL MEETING of the American Mining Congress was held at the Mayflower Hotel, Washington, D. C., Dec. 1–3, 1937. Principal interest centered in an address by Congressman Wesley E. Disney, of Oklahoma, on "Revision of the Revenue Laws". Mr. Disney expressed sympathy with many of the proposals recently made by business and industry for tax revision, particularly with reference to the undistributed profits tax and capital gains tax. He cautioned his audience, however, not to expect action at the special session of Congress, stating that the matter was too complex to receive adequate attention until the regular session convened in 1938. At the conclusion of his formal address he warmly urged mining men to make their sentiments on taxation known to their Representatives and Senators, so that Congress would have the full benefit of public opinion in drafting a new revenue bill.

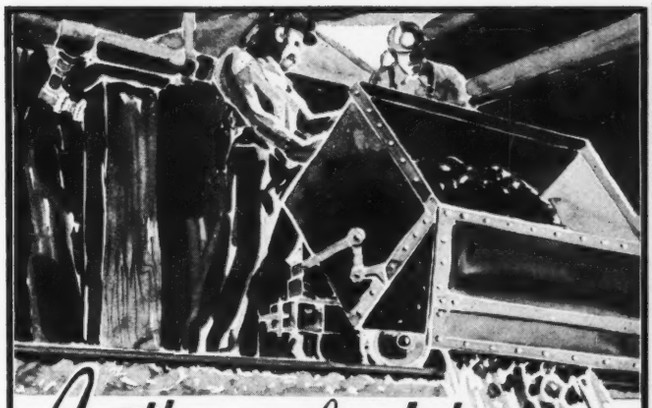
The Finance Committee reported a substantial cash balance in the treasury, and presented a budget of income and expenses for 1938. Increased contributions from member companies are requested in 1938 in order to carry on the legislative campaigns that have been undertaken on taxation and depletion.

The Secretary's report reviewed the activities of the Washington headquarters during the year and revealed unusually effective work in promoting the welfare of the mining industry and defending it against unwise legislation.

Two directors were elected for three years: William E. Goodman, president Goodman Manufacturing Company, Chicago, and Merrill E. Shoup, Golden Cycle Corporation, Colorado Springs, Colo. These directors succeed Eugene McAuliffe and D. B. Gillies. Re-elected as directors were Howard I. Young and J. R. Hobbins. Officers elected for 1938 were: Howard I. Young, president; D. D. Moffatt, first vice-president; E. B. Greene, second vice-president; D. D. Callahan, third vice-president; Erle V. Daveler, treasurer; Julian D. Conover, secretary.

Resolutions were embodied in a declaration of policy calling for immediate repeal of the undistributed earnings tax, and modification of the capital gains and losses tax. The tax resolution asks return to the flat rate corporate income tax. Other resolutions contained in the declaration deplore the accrual of a huge reserve fund under the Social Security Act, call upon Government to retire from business and production in competition with its citizens, demand simplified requirement for security registration and acceleration of administration of the Securities and Exchange Act as it relates to the mining industry, demand equal responsibility of employer and employee organizations in labor contracts, favor a currency with a metallic base and the employment of both gold and silver in our monetary system, endorse efforts to increase our international trade provided such efforts do not sacrifice any basic American industry for the benefit of any foreign country, condemn the sit-down strike as subversive in character and inimical to the public welfare, record opposition to the pending stream pollution control bill, and disapprove the withdrawal of public lands from mineral entry.

Looking north from the D.C. & E. shaft across the Oronogo Bottoms in the Tri-State zinc district. In the right foreground is the pump station of Eagle Picher Mining & Smelting Company. The Skinner shaft of the Webb City Lead & Zinc Company is in the left background near the base of the chat pile



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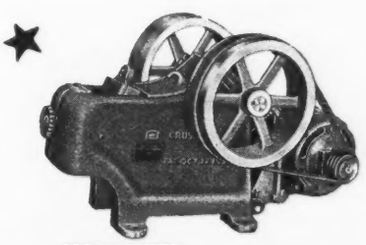

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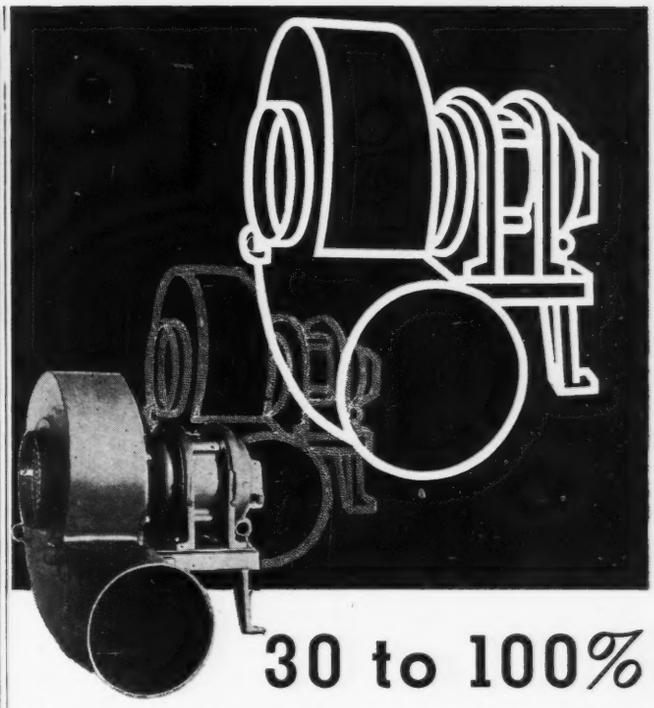

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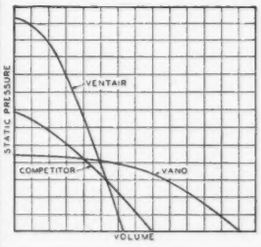

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Getchell Mill Nears Completion

Steady operations of mill and roasting plant planned in February—Consolidated Coppermines Corporation lowers copper output

▶ At the Getchell mine, in eastern Humboldt County, the 600-ton cyanide leaching plant is expected to be ready for operation around Jan. 20, according to a recent announcement by George Wingfield, president, of Reno, and N. H. Getchell, vice-president and manager for the Getchell Mine, Inc. The roasting furnaces will be in operation around Feb. 1. Sulphide ore, around two-fifths the volume now available, will be subjected to a roast at low temperature before entering the cyanide circuit.

▶ Consolidated Coppermines Corporation, operating at Kimberly, in the Robinson or Ely district, White Pine County, has been shipping 6,000 tons per day of high-grade copper ore to the McGill smelter of the Nevada Consolidated Copper Corporation, Kennecott subsidiary. Output was curtailed in December when a number of the unmarried mine employes were laid off. The company had been employing around 400 men. J. B. Haffner is manager at Kimberly.

▶ Replacement of the first diamond drill in use on Ruby Hill near Eureka by a larger unit with 3-in. bit has failed to overcome difficulties created by shattered limestone, and progress was again halted late in December with the drill down around 985 ft. P. W. Donovan, of the E. J. Longyear Company staff, arrived lately at Eureka from Minneapolis to assume charge of drilling, which is conducted under contract for the Eureka Corporation, Ltd., composed of Canadian operators. Glenn Anderson is manager for the corporation.

▶ Winter camps have been established and active work is in progress on several groups of claims near the Dick Pledge gold discovery, high on the Gillis range in central Mineral County. The Champion Mining Company has made final payment to Ben H. Donnelly, of Hawthorne, for the Hawaiian group on which high-grade gold ore has been found. The company has let a contract for a 150-ft. tunnel to cut the wide quartz vein below the shaft. L. E. Stein, of Golden Hotel, Reno, is head of the Champion Mining Company and Ben Donnelly is in charge of the mine.

▶ Reopening of the old Rip Van Winkle mine at Lone Mountain, in the Merrimac district 28 miles northwest of Elko, has aroused wide interest and attracted several engineers by reason of the volume and grade of lead-zinc-silver-gold ore exposed in new tunnel workings and at a vertical depth of over 350 ft. Edwin Seymour, manager for the group of Elko men financing the project, is quoted in a report to the effect that a sample cut across a width of 20 ft., together with other samples, gave assay values of $27 per ton. The mine was sampled lately by William Sharp, field engineer for the Tonopah Mining Company.

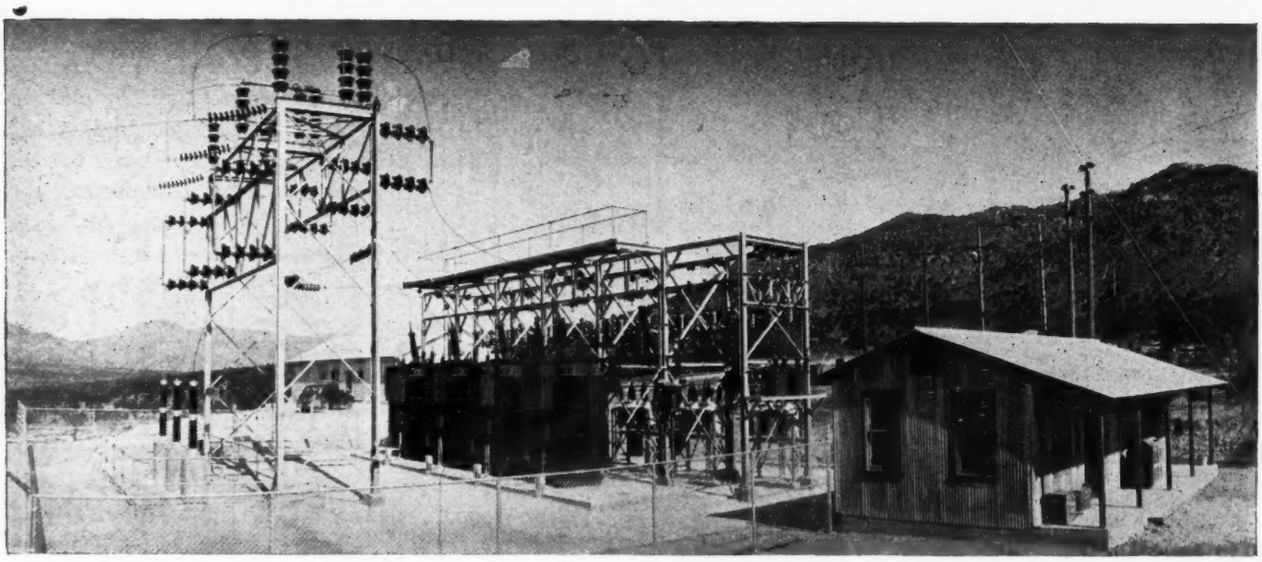
▶ Weekly shipments of gold-silver bullion are being made to the San Francisco mint from the recently constructed cyanide mill of the Marigold Mines Company at Unionville, Pershing County. Frank E. Horton, one of the successful pioneers of Goldfield and later in control of principal mines at Weepah, is head of the Marigold Mines Company.

▶ A 25-ton amalgamating and concentrating mill has been put in operation by the Manitou Gold Mining Company on its adjoining Desert Queen and Oro Fino mines, near Parran, Churchill County. The mines had been abandoned for some 40 years. Wilford Dennis is manager.

▶ The Nevada Rand Mining Company has been organized to acquire and operate the Nevada Rand mine, in the Rand or Bovard district, 15 miles from Nolan, shipping point on the Mina branch of the Southern Pacific Railroad. The new owners plan to ship a carload of ore daily from stopes prepared on the 250-ft. level of the 450-ft. shaft. The mine, productive around twenty years ago, has been idle since, but workings and surface plant are in good condition. The heads of the new project are Harry and B. A. Asner, brothers, and W. F. Jamieson, engineer formerly of Colorado, who is in charge.

▶ The Buckhorn mine and 100-ton flotation mill, operated for something over two years by the Pardners Mines Corporation and situated in Eureka County, 6 miles from Cortez, have been closed down permanently and the mine and mill equipment advertised for sale. Carlos W. Van Law has been manager for several months.

▶ A custom mill with all-new equipment, constructed lately by the Westgate Mining & Milling Corporation at Westgate, Churchill County, is treating 45 tons of free-milling gold ore per day by amalgamation, and installation of a flotation unit of around 60 tons' capacity will



Boulder Dam power, released on Sept. 1, 1937, to the Pioche zinc-lead-silver district, in Nevada, is now utilized by many mine operators. Energy also provides for electrometallurgical and electrochemical research on manganese and other minerals found in the Boulder Dam district. Near Pioche is the Prince 5,000-kva substation shown above. It is 156 miles from Boulder Dam

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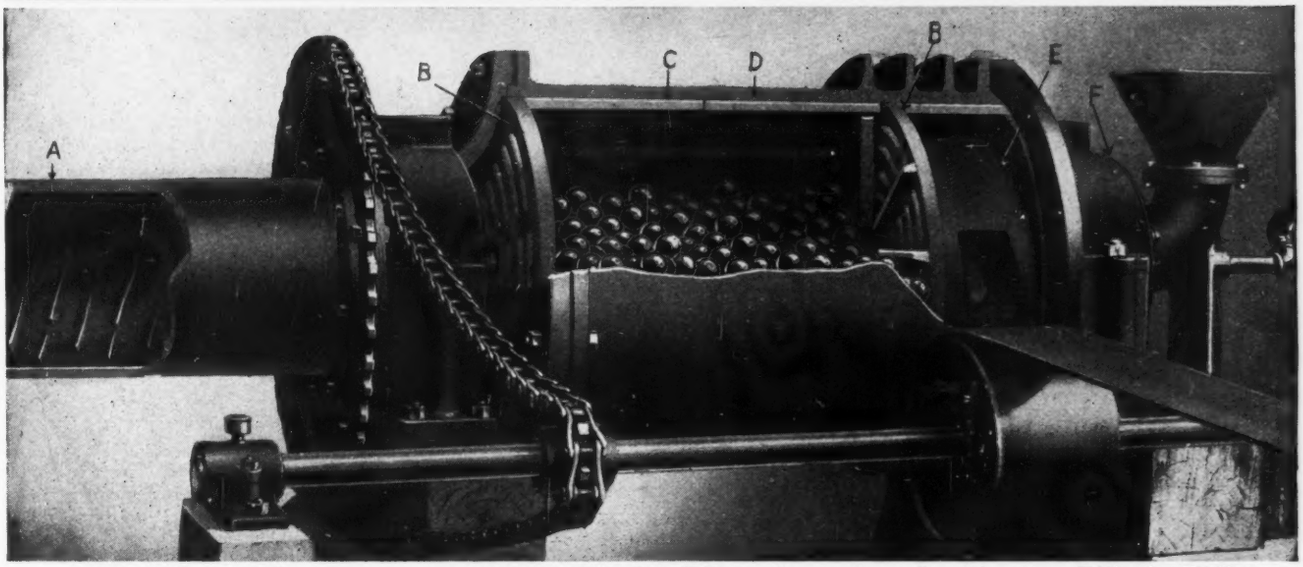

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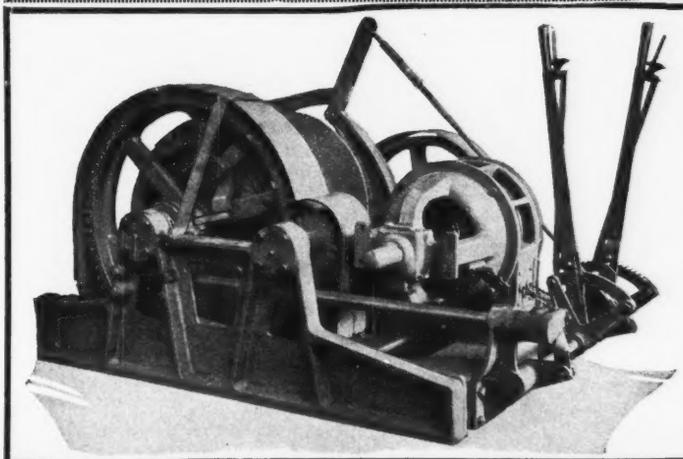

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▶NEVADA

soon be completed. Early in the spring a cyanide department will be added. E. S. Montgomery, of Fallon, is manager.

▶ All work has been suspended for the winter months at the Jumbo mine and 40-ton amalgamating mill in the Awakening district, Humboldt County. Other properties in the area, controlled by the same interests, wealthy Texas oil men, also will remain idle.

▶ J. O. Elton, manager for the International Smelting Company and president of Mountain City Copper Company, has been at Elko to cooperate with Nevada highway officials in effecting needed improvement to the road between Mountain City and Elko. Mountain City Copper has been trucking some 300 tons daily of crude ore and flotation concentrate to Mountain Home, Idaho, for rail shipment to the International smelter at Tooele, Utah, but this road probably will soon be blocked by deep snow, and it is now desired to use the shorter outlet to the south.

MEXICO

Oil Industry Upset by Labor Board Verdict

Producers ordered to accept collective contract with their workers and to raise wages—Mining industry apprehensive of similar fate

▶ Metal producers in Mexico have become alarmed by the Government's recent ruling favoring a collective labor contract and a pay increase for oil workers. It is feared that a similar ruling may be demanded by the miners and if allowed would probably hit mine operators harder than the oil industry. Oil companies affected by the ruling call the verdict a glaring disregard of justice and assert it is based upon erroneous and distorted figures. American officials of oil companies operating in Mexico have been trying to work out proposals for a compromise to present to the Mexican Government under which it would be possible to continue operations there.

▶ The 1,500 miners who are working properties of the British-owned Dos Carlos Mining, at Pachuca, Hidalgo, on a cooperative basis have been given definite possession of the property and assured Federal Government backing to the extent of 300,000 pesos (about $83,350).

▶ The national miners' union has asked Congress to amend the mining laws to provide that the mines and other properties of companies that suspend work without official sanction be given to their employees to run on a cooperative basis.

▶ The basic object of the Mexican cooperative society program is to assist prospectors and other small-scale operators to exploit mineral deposits, announces the Ministry of National Economy. This, too, is a prime reason for the constitution of Federal mineral reserves. Prospectors are being organized into cooperatives for the exploitation of various gold and tin deposits, working of which is inexpensive. Special efforts are being made to develop unexplored mining zones because, "The lack of prospecting in the remote regions that are almost virgin, of which there are many in Mexico, has resulted in development of zones that were discovered centuries ago and have been almost entirely absorbed by great foreign enterprises."

▶ Operations have been resumed by Cia. Minera El Tajo, S.A. in Rosario municipality, Sinaloa, after a shut down due to labor troubles.

▶ Production of non-ferrous metals and minerals in Mexico in the first eight months of 1937, with comparable figures for 1936, in kilograms, according to the Mexican Department of Mines, follows:

	Jan.-Aug. 1936	Jan.-Aug. 1937
Gold	16,223	17,779
Silver	1,705,063	1,868,557
Copper	20,395,465	33,322,110
Lead	141,945,081	158,254,154
Zinc	105,159,381	103,749,611
Quicksilver	134,644	108,412
Antimony	5,485,550	6,828,528
Graphite	6,775,242	8,856,225
Arsenic	7,569,049	8,782,883
Molybdenum	536,630	733,448
Bismuth	112,951	112,098
Cadmium	403,163	350,945
Tin	275,397	247,697
Tungsten	37,035	16,447
Selenium	280	.....

▶ Exports of metal during June, the most recent month for which official figures are available, were in kilograms: Gold, 7,456; silver, 217,104; copper, 5,852,340; lead, 23,237,505; zinc, 14,516,742; antimony, 499,367; graphite, 1,475,854; mercury, 13,523; arsenic, 1,446,457; cadmium, 124,772; tin, 61,939; molybdenum, 124,561; and bismuth, 165,558. June domestic consumption of metals and minerals was, amounts in kilos: gold, 2,339; silver, 102,096; lead, 407,727; zinc, 749,425; mercury, 690; arsenic, 612; and tin, 837.

▶ Cia. Minera de Zimapan, S.A., is improving its 75-ton reduction plant at Zimapan, Hidalgo. This company is arranging to increase production. It has obtained as high as 400 kg. of silver in a month.

▶ Another mining company, Cia. Minera de Promontorio, S.A., operating at Promontorio and Estacion Chinacates, Durango, has passed into the hands of its employees to conduct on a cooperative basis. The agreement, approved by the Federal Labor Department, provides that the company shall pay the workers wages for the time they were on strike last summer and give them the mines, machinery, and other property. The workers assume the company's obligations and are to pay it a 30 per cent participation in its profits for seventeen years, a share that ceases if the workers sell, rent, or lease the property. The cooperative is seeking financing to assure early resumption of work of the Promontorio property, which has been suspended.

▶ Regular production is being arranged by The Golden Girl Mining Co., at Providencia, Nayarit. Carlos Perez Quarte is general manager. The company has been developing the mine for the past two years and has installed an aerial tram service. During the year ended Nov. 1, this firm obtained some $250,000 in gold.

▶ A mill is to be built by Cia. Minera el Palero at Guanacevi, Durango, manager of which is Harold M. Cobb, soon after the crosscut that is being run from the Verde to the Palero vein is completed during the winter. The company has installed a compressor and diesel engine.

▶ An important gold strike was made by prospectors in Los Moris district, Chihuahua. Gold values as high as 12 kg. per metric ton are reported. The Federal Government has granted 45 prospectors rights to the strike.

▶ Employees have been given charge of the smelter and foundry at Apulco to conduct on a cooperative basis by the Federal labor authorities.

▶ Hiram T. Horton, former president of the Chicago Bridge & Iron Company, has recently purchased and had shipped to his El Fenomena mine, near Ensenada, Lower California, a complete 50-ton milling plant to produce high-grade tungsten concentrates. The plant was assembled by Southwestern Engineering Company, of Los Angeles. Treatment will include crushing, screening, grinding, tabling, and re-treatment of table concentrate by flotation to remove copper and bismuth which is present in the ore. The plant is scheduled to go into production early in January.

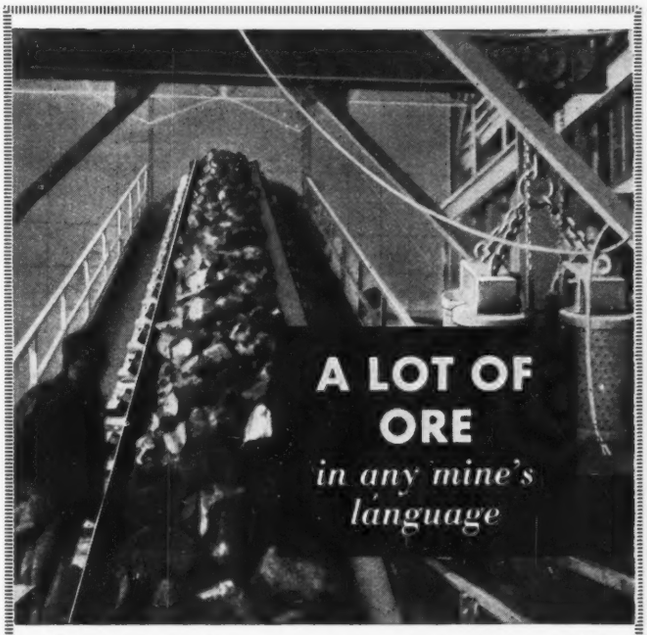
CANADA

New Mills Ready for 1938 Production

More capital required for developing encouraging prospects in many districts—British Columbia passes new laws affecting the mining industry

▶ The output of Canada's metal mines is expected to be considerably augmented in 1938 by various new mills that are now in course of construction. Whether progress on the same scale is to mark prospecting activity will depend largely on the amount of speculative capital available. The year just ended showed a considerable slowing down of exploration efforts, a trend that may interrupt the fast pace in opening up new territory that the last two years of successful financing have made possible. Many new districts offer encouragement, but the steady flow of money needed for aggressive prospecting is not available in sufficient volume. One of the unfavorable factors responsible for the situation is government interference.

▶ From the time ore was first discovered in a drill hole on the Moneta Porcupine property a 200-ton mill was put into operation within the short space of sixteen months. The ore has been opened



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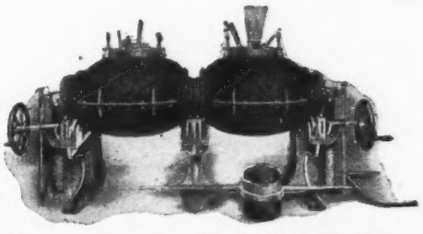

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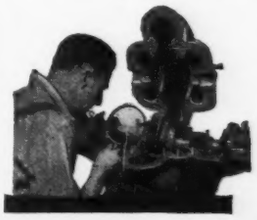

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▶CANADA

up on four levels to a depth of 525 ft., with estimated tonnage sufficient to keep the mill supplied for three years. Grade averages $20 per ton. The main shaft is being deepened and is expected to be bottomed at 1,000 ft. before the end of January. Raising from the second level to surface will be completed before drifting is started on the three new levels.

▶Healthy expansion of the mineral industries in Canada is demonstrated by the 34 per cent increase in dividend payments during the year just ended, compared with 1936. The total amount to be paid before the end of December by 49 companies is $105,266,890, which includes initial dividends from seven new producers. The return on International Nickel common stock increased from $18,959,232 to $32,814,056 in 1937; Lake Shore's disbursements reached an all-time high of $12,000,000, and Consolidated Smelters went up to $11,420,447. Thirteen other mining companies contributed more than a million dollars each to the year's record total.

▶Early in March the MacLeod-Cockshutt 300-ton mill is expected to be in operation. Mine development has resulted in opening up five separate orebodies, the average grade being $9.73. The intention to use hand sorting may result in higher-mill heads. What appears to be the same oreshoot has been picked up on the second level, where gold values have increased to $24.50 per ton. Total drifting on three levels amounts to 8,600 linear feet, of which 2,400 ft. represents ore of an average width of 10.2 ft. At a depth of 200 ft. the porphyry zone has a length of 950 ft.; on the 500 level the length increases to 1,800 ft. A thousand feet below that horizon the management expects to find the length of the favorable porphyry zone extending for 4,000 ft.

▶Tombill Gold Mines and Hard Rock Gold Mines, both neighbors of MacLeod-Cockshutt, in the Little Long Lac area, will be in production early in 1938. Tombill, owned by Newmont, is building a 100-ton concentrator which will recover part of the gold by amalgamation and will ship concentrates to the near-by cyanide mill operated by Northern Empire, another Newmont enterprise. T. H. Rea is president of Hard Rock. Operating costs for the new mill of 150 tons' daily capacity are estimated by Fraser D. Reid, consulting engineer, to be about $7 per ton.

▶The 250-ton mill of Sladen Malartic Mines is scheduled to begin operating early in January, with two years' ore reserves of an average value of $9 per ton. Costs have been estimated at $5. Development work has put in sight a considerable additional tonnage of $7 material, which will probably be drawn for mill feed as soon as equipment can be expanded to treat 500 tons daily.

▶East Malartic Mines, adjoining the Sladen, is preparing to start construction of a 500-ton mill as soon as metallurgical tests have been completed. As estimated by J. P. Norrie, consulting engineer, operating costs will not exceed $2.50 per ton. The new shaft has reached a depth of 500 ft. and a main haulageway has been established on the 335-ft. level.

▶In December production at Powell Rouyn Gold Mines was increased to 300 tons per day. The ore is hauled 3 miles by truck to the Noranda smelter. In January the shipping rate is to be advanced further to 500 tons, following completion of shaft sinking to 800 ft. Most of the ore to date has come from the 500-ft. level, which resembles conditions being met in opening up a new working horizon at 650 ft.

▶Lake Dufault Mines was recently incorporated to acquire a large group of claims 5 miles north of Noranda and adjoining the east boundary of Waite Amulet. The new company is controlled by Ventures Limited. Area Mines also hold a large interest. Known copper occurrences on the consolidated properties are to be systematically explored.

▶Development work on the Quebec Manitou property continues to improve the ore picture and to strengthen the possibilities of mill construction within the near future. The new three-compartment operating shaft had reached a depth of 320 ft. on Dec. 20, and lateral exploration is to be started in January on the 360-ft. level. At this horizon diamond drilling indicated the ore width to be 25 ft. containing gold, silver and zinc.

▶J. Y. Murdock, president of Noranda Mines, has announced a million-dollar appropriation for Hallnor Mines, Noranda's subsidiary next to Pamour, in the Porcupine camp. Construction of a 400-ton mill will be started at once, with production scheduled to start next July. The combined annual gold output from Hallnor and Pamour is expected to reach the impressive total of $6,000,000. Noranda's metal output in 1937 is estimated at $19,000,000 divided about equally between gold and copper. To accommodate recent increases in copper production, as well as the growing business with custom shippers, Noranda's subsidiary in Montreal East, Canadian Copper Refiners, is being enlarged to a capacity of 80,000 tons per year.

▶Kerr-Addison Gold Mines, Ltd., Larder City, Ontario, is sinking No. 1 and No. 3 shafts to 700 and 775 ft. respectively. Haulage levels between the two shafts will be on the 300-, 500-, and 700-ft. levels. Development will start on the 300-ft. level and above, in preparation for starting production around April 1, 1938, and treating the gold ore in a 500-ton unit cyanide mill now under construction. Diamond drilling during the last few months has served to verify estimates of ore reserves down to the 500-ft. horizon and has also indicated prospects for additional tonnage. G. B. Webster is president, M. F. Fairlie and W. H. Emens are consulting engineers, and W. S. Row is mine manager.

▶Legislation affecting mining in the Province in several important respects was passed at the recent session of the House. The Securities Act was strengthened by providing for greater regulation by the Superintendent of Brokers. In future all companies must advise the Superintendent of material changes in their properties, assets, or financial condition, and he may then require that such information be published. The Attorney General is now also given the power to prohibit a stock exchange or any person from trading in a security. Passage of the Industrial Conciliation and Arbitration Act establishes the legal right for employees, and employers, to organize into associations. Imposition of certain responsibilities on such organizations is likely to have a beneficial and stabilizing effect on labour relations in the Province. Arbitration of disputes is made compulsory, and strikes and lockouts are prohibited until two weeks after arbitration proceedings have been completed. Coal-mining interests are seriously concerned in an act which provides for the establishment of a board to control the coal and petroleum industries of the Province. The act was passed on the strength of the report of a Royal Commission that coal and gasoline prices in British Columbia are too high, a conclusion strongly and with good reason contested by the interests concerned.

▶The 225-ton mill of Polaris-Taku Mining Company, Ltd., was brought into operation at the beginning of November. It is situated on the Taku River in the Atlin district, and is the most northerly concentration plant in the Province. In the past two years the Edward C. Congdon interests, of Duluth, Minn., have developed sufficient ore to operate the mill for several years. An excellent camp has been built, accommodating 125 men, and the plant includes a 700-hp. hydro-electric power unit and a 420-hp. diesel power unit. Mill feed at present amounts to about 165 tons a day, averaging approximately ½ oz. gold. The quantity and grade are to be gradually increased. D. C. Sharpstone, geologist and consulting engineer, is in charge of the operation and B. B. Nieding is general superintendent. George G. Griswold, consulting metallurgist, designed the mill.

▶At the Big Missouri mine, Portland Canal district, machinery is being installed for the 500-ton underground mill. The mill chamber was formed by the excavation of 86,000 tons of rock.

▶Extremely high-grade ore is being developed at several properties at Zeballos River, Vancouver Island, British Columbia's new gold mining camp. Since last June a considerable quantity of ore has been shipped to the Tacoma smelter from the Privateer, one of the two developed mines in the area. Of this, 84 tons averaged 13.2 oz. gold per ton. It was mined from a 7-in. vein for a distance of 250 ft., the mining height being 6 ft. A camp to accommodate 60 men is being built at the property. The road to the other established mine, the Goldfield, will soon be completed, whereupon machinery for a small mill will be shipped in. Ray Pitre is manager of the Privateer, and P. W. Racey is the engineer in charge of the Goldfield.

▶The concentrating plants at the Noble Five and Whitewater mines, in the Slocan district, after a short period of operation, have been closed because of the low prices of lead and zinc. At the

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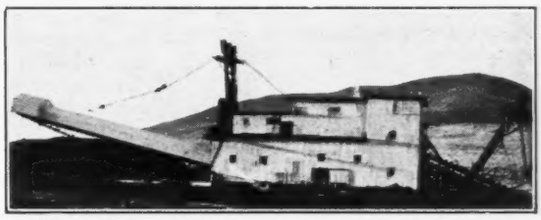

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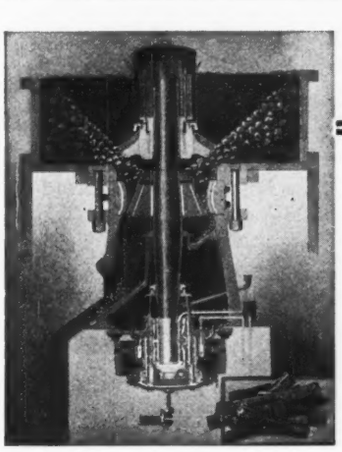

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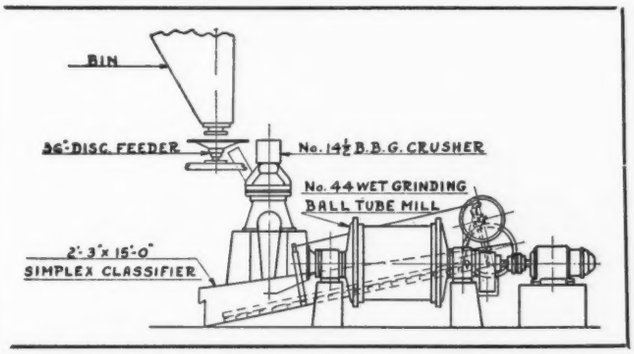

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▶CANADA

same time, it is learned from James Anderson, secretary of Lucky Jim Lead & Zinc Company, that milling has been resumed by that company to fill an order for 500 tons of zinc concentrate, which will constitute a trial shipment to Japan. Japanese interests recently also took a trial shipment from the Whitewater, and it is possible that a market may develop there for the output of Slocan mines.

▶Operation of the 100-ton plant of Durango Gold Mines, Ltd., near Ymir, was commenced in December. The ore is transported 5 miles by aërial tram from the mine to the mill. The manager, A. W. Davis, reports that in preparing the stopes for mining the ore has been opened across greater widths, and better values have been found than were previously estimated.

▶Diamond drilling at the 1,500 level recently has encountered a showing thought to be the downward continuation of the hanging-wall vein of the Ymir Yankee Girl Gold. At the annual meeting R. B. Lamb, of Toronto, was appointed managing director and L. C. Morrell mine manager. E. P. Crawford, of San Francisco, is president.

▶Development work has been resumed at the Vidette, Kamloops district, after a brief shutdown necessitated by the lack of funds with which to open up the indicated orebodies. Production will not be resumed for the present.

AUSTRALIA

Underground Conveyor System at Lancefield

Will handle transport ore from deeper levels—Lower-grade copper ore treated at Mount Lyell

▶Latest results from Lancefield Gold, Beria, W.A., are that at the lowest (No. 13) level, the drive has been extended to 213 ft. from the plat. Values have, however, been rather erratic and the lode was disturbed and broken over the last 70 ft. Whether or not this is merely a local pinch must await the result of further work. Ore has been indicated by a series of boreholes to extend to 840 ft. below No. 12 level. Installation of the first section of the underground belt conveyor system, to handle ore from the deeper levels, is nearing completion. A. E. Faul is mine manager.

▶Western Mining Corporation has optioned a new find at Mount Ida, in the Menzies district of Western Australia. The reef so far has been opened to a small depth only, over a length of 400 ft.

▶Ore at the 1,800-ft. level of Wiluna Gold Mine, Wiluna, W.A., is proving to be of lower grade and width than at the 1,400- and 1,600-ft. levels, particularly in the East lode. Exploratory work to establish more definitely the characteristics of the deeper ore zones, which has been in progress for some time, is being expedited.

▶South Kalgurli Consolidated, Ltd., Kalgoorlie, W.A., reports reserves at Oct. 30 of 285,700 tons proved and probable ore averaging 5.6 dwt. per ton. These reserves are practically unchanged from those reported a year ago, and represent about 3½ years' supply at the present rate of treatment.

▶Cocks Pioneer Gold & Tin Mines, Eldorado, Vic., has proved, by boring, additional sluicing ground, the total new yardage developed so far being 12,000,000, of an estimated average value of 12d. per cubic yard. Values in the new ground extend for a depth of about 100 ft. lying below 80 ft. of overburden carrying no gold, and a new dredge will be necessary to treat the material. R. J. Falconer is mine manager.

▶Cocks Eldorado Gold Dredging, which is operating (at Eldorado, Vic.) the largest dredge at present working in Australia, made a net profit for the year to Sept. 30 of £41,590. Yardage treated was 1,899,816 for a production of 6,485 oz. gold and 115 tons tin concentrate. Average value was 10.16d. per cubic yard and costs including depreciation of £10,000 (equivalent to 1.27d. per cubic yard) totaled 4.91d. D. P. Fletcher, 405 Collins St., Melbourne, is consulting engineer.

▶The Bendigo (Vic.) field has suffered a setback in the cessation of operations at the Napoleon and Nell Gwynne mines, subsidiaries of Bendigo Mines, N.L. Extensive developments have disclosed considerable bodies of ore, but the grade has been well below the average of the field, and unpayable. The Carshalton mine, of the same group, will continue operations for the time being, as the grade of ore being treated is high enough to show a small profit.

▶The Industrial Court of Queensland has awarded to employees of Mount Isa Mines, Ltd., a prosperity bonus to be paid according to the price of lead, commencing with 6d. per shift when lead is £20 Australian (£16 sterling) and increasing by 6d. for every £1 rise in the price up to a limit of £31 Australian (£24.8 sterling). This arrangement is similar to the bonus in force at the Broken Hill mines, except that the latter commences at a lead price of £16 Australian. An application for a 40-hour working week was refused, however, but is likely to be entertained later should the prosperity of the Mount Isa industry improve appreciably.

▶Two of the lodes now being worked by Golden Plateau, Cracow, Queensland, at the 287-ft. level, have been cut in development work at the 444-ft. level. Values are averaging about 8 dwt. per ton, which is above the average of present ore reserves. These are the lowest workings in the mine at present, and are expected to add about 50,000 oz. to reserves, which at present total 69,000 oz. For the year ended June 30 the company has reported a net profit of £155,663 resulting from the treatment of 48,453 tons for a yield of 25,834 oz. fine gold, a reduction in profit of £40,000 compared with last year. The reduced profit is ascribable to lower grade of ore and increased working costs (25/2 per ton, compared with 21/8), due mainly to the introduction of the 40-hour week and the greater proportion of ore requiring underground mining, instead of open-cutting. Ore reserves at June 30 are given as 237,000 tons averaging 6.5 dwt. per ton, compared with 233,000 tons (8.0 dwt. per ton) a year earlier. The company is aiming at the steady production of 2,000 oz. gold per month, and in consequence of decreasing grade is gradually increasing the tonnage treated, which is at present about 4,600 per month.

▶North Broken Hill, Ltd., had ore reserves of 5,021,000 tons as at June 30 last, an increase of 271,000 tons for the year. In addition, a considerable tonnage has been disclosed by diamond drilling which has not been taken into account. In this work the continuity of width and grade of the lode at the 2,300-ft. level was proved, 300 ft. below the present bottom working level. Completion of the new mill, originally expected to be in July next, has been delayed by late delivery of material until September.

▶Silver Peak (Broken Hill), Ltd., a prospecting company carrying out diamond drilling to the north of the leases of North Broken Hill, has encountered a lead carbonate lode at the depth of 108 ft. in its latest borehole. The drill at latest report had passed through 45 ft. of lode and was still in ore.

YUGOSLAVIA

Plant Construction at New Lead Producer

Concentrate shipments from Zletovo Mines expected in February—Metallurgical difficulties overcome at Kapaonik Mines

▶Zletovo Mines, Ltd., reports erection of treatment and power plants, an aërial ropeway well advanced, and expectation that production of lead-silver concentrates will begin in February, 1938. Its mill is being erected at Probistip, where a coal mining concession has been acquired and a mine developed which will supply the company with all fuel requirements. An aërial ropeway only 3.5 km. long will connect the mine with the mill. The distance from the mill to the railway is 22 km., and the concentrates will be transported this distance by trucks over a road now being constructed by the government. Zletovo has 948,000 tons of 11.5 per cent lead and 1.7 per cent zinc ore, averaging 3.5 oz. of silver per ton, developed in its Dobrevo mine, and also a promising undeveloped prospect. It will treat 10,000 tons of ore monthly, at first recovering only the lead and silver. As a crushing unit of 50 tons' per hour capacity has been installed, the plan evidently is to increase the mill later.

▶The property of Novo Brdo Mines, Ltd., continues in the stage of explora-

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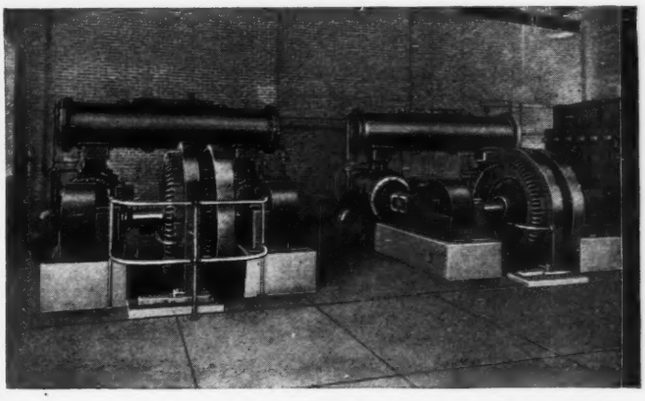

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▶YUGOSLAVIA

tion. Development on the 635-meter level of its Velika Planina prospect disclosed a horizontal area of over 6,000 square meters of gossan, but diamond drilling to depth failed to disclose either gossan or sulphide ore. In consequence, exploration work has been transferred to the Prlina-Kijnitsa prospect, where gossan and lenticular masses of sulphide ore of good grade were encountered in preliminary exploration several years ago.

▶For the year to Sept. 30, Trepca Mines, Ltd., earned £632,470 net, after charging £44,798 to depreciation and reserving £266,676 for taxation. The big item of taxation is due to the income tax on dividends being paid by the company, stockholders receiving 1s. 6d. per share tax free. Net was 56¼ per cent on the total issued and realized capital. Ore reserves were increased by 600,000 tons during the year (despite 638,729 tons being mined and treated) and now stand at 3,900,000 tons averaging 9.5 per cent lead, 5.2 per cent zinc, and 4 oz. of silver per ton. Operating costs were 19s. 3d. per ton, against 16s. 10d. the previous year, the increase being chiefly due to higher wages and advanced cost of materials. In addition to sales of lead-silver and zinc concentrates, Trepca sold 82,005 tons of pyrite concentrates, the demand for the last having now caused the company to install a flotation plant for the recovery of pyrite from old tailings. An experimental flotation cell with necessary equipment has also been installed for the recovery of the copper found in the deeper ores, and though metallurgical improvement is still expected, a 16 per cent copper concentrate is already being recovered. In the exploration of other mineral occurrences within its concession area nothing of commercial value was discovered during the year. The orebody in the Stantrg mine is showing a considerable increase in horizontal area in the 545-meter level where 8,585 square metres of ore has now been developed. A similar expansion is already indicated on the 485, which is the next level below. Work has now been started on the 435-meter level. The proved reserves in this orebody have increased from year to year while over 3,600 000 tons were being extracted. In November Trepca produced 5,392 tons of 80.50 per cent lead concentrates averaging 27.5 oz. silver per ton, and 6.054 tons of 49.59 per cent zinc concentrates, from the treatment of 49,321 tons of ore—all tons are metric.

▶Kapaonik Mines, Ltd., the new Yugoslavian producer, treated 10,727 tons of ore in November in the Trepca mill, recovering 1,084 tons of 76.30 per cent lead concentrates assaying 29.6 oz. of silver per ton, and 1,010 tons of 48.34 per cent zinc concentrates. During six months ended with October, Kapaonik recovered 3,972 tons of 73.45 per cent lead concentrates averaging 28.83 oz. of silver per metric ton, and 4,411 tons of 47.22 per cent zinc concentrates. Partly oxidized ore and the presence of certain impurities made metallurgical results unsatisfactory, and difficulties incident to starting operations accounted for the high costs, 32s. 3d. per metric ton of ore. Costs have now been reduced to 25s. 7d. per ton, and recoveries and the grade of concentrates are being improved. Grade of ore so far treated by Kopaonik has been 9.11 per cent lead, 7.91 per cent zinc, and 3.736 oz. of silver per metric ton.

AFRICA

New Cyanide Plant Near Lake Victoria

Mill will treat ore from Geita Gold Mines —Rains relieve power shortage at Rhodesian Broken Hill, permitting greater electrolytic zinc production

▶Kentan Gold Areas, Ltd., announces in its report for the year ended Sept. 30 that it has written off £465,205 15s. 6d. in respect of other companies' shares held, and in consequence there was a loss of £478,096 12s. 3d. for the year. Arrangements have nevertheless been made for the erection of a mill of 250 tons' daily capacity, to serve the mines it and its subsidiary, Geita Gold Mining Company, have developed in the Saragura (Sanza) Concession immediately south of Lake Victoria, in Tanganyika Territory. The mill will occupy a central position to the mines, in which 474,124 tons of developed ore averages 4.82 dwt. per ton, or, allowing for a 10 per cent dilution, 521,536 tons averaging 4.4 dwt. Pilot tests have demonstrated a recovery of 92 per cent of the gold by cyaniding. The estimated cost of the installation is £460,000, and the Tanganyika Concessions and the Zambesia Exploring companies will provide the funds by purchasing Geita Gold Mining debentures.

▶During the year to June 30 Kiminginni Gold Mining Company, operating in the Kakamega district of Kenya Colony, milled 32,423 tons of ore and recovered 9.220¼ oz. of gold. The revenue from this was £64,994 and the cost, excluding depreciation, was £68,656. Since the year ended—that is, for the four months ended with October—operating results have begun showing a small surplus.

▶Rhodesia Broken Hill Development Company, in Northern Rhodesia, produced 600 tons of zinc, 46 tons of vanadium concentrates, and 28 tons of fused vanadium in November (all long tons). Its decreased output of zinc during the past several months was necessitated by lack of power from its hydro-electric installation, due to a long-continued failure of the rains. Meanwhile, activities have been directed to development and there is a good market at satisfactory prices. It is reported that sufficient rain has now fallen to permit of a considerable increase of its zinc output.

▶Gold Coast Selection Trust is paying an initial interim dividend of 10 per cent, tax free. Though this is the first regular dividend, capitalized bonuses of 10 per cent and 200 per cent were distributed in 1932 to holders of deferred and ordinary shares respectively, when the company's assets were revalued. It has large holdings of Marlu Gold, Ariston Gold, and Amalgamated Banket Areas, as well as others.

▶Kwahu Mining (1925) has declared a dividend of 25 per cent, tax free, on account of the year ending June 30 next. This is the first distribution made by the company, which owns mining leases and shares in West African gold-mining companies. The latter were acquired by selling proved properties to other companies, but Kwahu's more recent explorations appear not to have been fruitful. It has nevertheless been one of the outstanding successes of the Gold Coast mining revival, its shares of 2s. par (only £40,000 capital) being quoted now at above 30s.

▶Bushtick Mines (1934), Ltd., has declared an initial dividend of 5 per cent. This company is operating one of the old, very low-grade mines in Southern Rhodesia. Its revenue per ton was only 18s. 5d. for the year to June 30, despite which it was able to report a net profit of £30,877. The low yield was partly due to the milling of all ore broken in development, as its reserves are calculated at 345,000 tons averaging 3.49 dwt. per ton. During the year 134,500 tons were milled and about 60,000 tons added to reserves. The plant capacity, formerly 10,000 tons per month, has been increased to 15,000 tons, the addition beginning operation in July, after the year reviewed had ended. By driving east into undeveloped territory, an area of ore 10 ft. wide averaging 8.9 dwt. per ton has been found, and a shaft is being sunk to prove whether this persists at depth. Bushtick is demonstrating that $4.60 ore can be worked at a profit even now. If it becomes high grade it will lose that feature of interest.

▶New methods of dust and moisture removal underground which are likely to have a revolutionary effect on Rand mining practice are undergoing trial on several properties. "Electrostatic precipitation" is the term coined to describe the system, which is coming into increasing use in Reef mines. The pioneer installation on the Nourse Mines, which has been running for nearly a year, will soon be followed by another on the Modder East mine and two more on other mines. So important are the implications which the industry attaches to the preliminary work, that the Inventions Committee of the Mine Managers' Association is understood to be devoting special study to its further adaption. All apparatus is being constructed locally, and thanks to the ingenuity on the part of the local engineers—particularly those of the Central Mining-Rand Mines Group—substantial savings have been effected compared with over-sea prices. The method, which is practically the same as used in other countries for cleaning smoke, has been specially adapted for underground mining. Further investigations are proceeding to ascertain whether the electrical precipitation cannot be adapted directly to the huge ventilating fans used underground.

▶Marlu Gold Mining Areas (Gold Coast, Africa), formed in 1934, is paying an initial interim dividend of 15 per cent, taxable.

EQUIPMENT NEWS

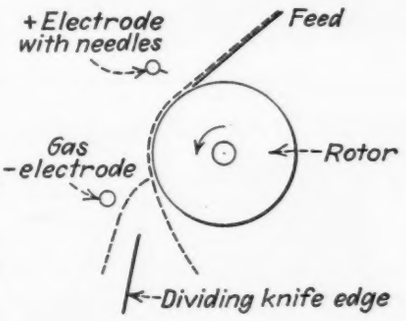
Some Features of Equipment Displayed at the Chemical Exposition

AT THE 16th EXPOSITION of Chemical Industries held at Grand Central Palace, New York, Dec. 6 to 11, it was apparent to a visitor from the mining industry that products from his field, such as copper, lead, nickel, molybdenum, tungsten, platinum, and more recently titanium and zirconium, have found a place of important usage in aiding the rapid progress of the chemical industry. It is important, however, that producers of base metals keep a watchful eye on the growth of one of chemistry's "Children of Prosperity" named plastics. Exhibitors, including those better known to the mining and metallurgical industry, offered suggestions that efficiency in the various phases of the mining industry might be improved by equipment used in the various processing units of the chemical industry which include, crushing, grinding, mechanical separation, filtration, flow of fluids, flow of heat, handling of materials and fuels, and production of power.

Among equipment for grinding was a newly designed reverse-current air classifier by the Hardinge Company, of York, Pa., for use in connection with its conical ball mill. Maintainance of unusual accuracy in product fineness and greater mill capacity is said to be a feature of the unit.

A new weight control for dry material was shown by the Toledo Scale Company, Toledo, Ohio. The unit is called the Totalizer, or weight indicator, and may be installed with any belt conveyor system to measure material into or out of storage; between processes or departments or in some cases to proportion two or more materials automatically and continuously. The principle of operation, involving the two variables (1) belt loading per unit length and (2) rate of belt travel, is adjusted by an electrical device known as the Belt Speed Compensator which detects any changes in belt speed and projects those variations into the Totalizer. The Totalizer is said to combine automatically or multiply the two variables automatically and translate them into motion in the counter on the face of the Totalizer unit. The weight indicator (Totalizer) is connected by wiring and can be placed near the weighing scale or may be installed in the mill office, permitting the reading of tonnage without going directly to the mill.

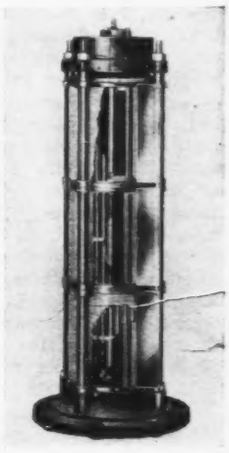
For electro-static separations and cleaning or grading of ores and minerals the Separations Engineering Corporation, 110 East 42d St., New York, N. Y., displayed a new unit called the Electro-Static Separator, manufactured by Sutton, Steele & Steele, Inc., Dallas, Tex. Feed, such as rutile, fluorspar, sheelite, pyrite, or mica, is heated and discharged from a hopper, and as it passes a positive electrode carrying a multitude of needle points charged to a high voltage, the particles become positively charged and drop onto a rotor, where some particles lose their charge more quickly than others. Particles retaining a longer charge cling to the rotor and are carried farther than other particles which are induced to lose their charge by a negatively charged glass tube containing a suitable gas. A new type of magnetic separator was exhibited by the S. G. Frantz Company, 161 Grand Street, New York, N. Y. The device is said to remove iron contamination caused even by feebly magnetic and very fine particles in suspension in liquids. The manufacturer states that particles of ilmenite at least as small as one micron in diameter have been caught by the Ferro Filter. The design of the equipment is said to be based on a new application of the physical laws of the interaction of mechanical and magnetic forces on small particles in a viscous medium. The magnetized particles are caught on a series of screens which can be removed and cleaned when necessary.



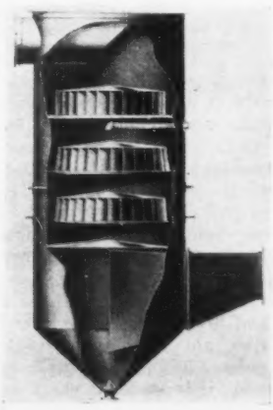
The Newark Wire Cloth Company, Newark, N. J., demonstrated its End-Shak testing sieve shaker, a device which gives a combined reciprocating and turning motion to the several screens it holds. A set of small hand sieves which stack into a pile small enough to be conveniently carried in a hand bag was also shown. Another new set nests the sieves one within the other so the entire group occupy space little more than a single screen.

Equipment for separation of solids from liquids and devices of clarification were well represented. A wire-wound filter arranged for automatic backwashing with a portion of the clean fluid was shown by the Cuni Engineering Corporation, Meriden, Conn. Its principal field is in the removal of abrasive particles from liquids, as water and heavy oils and greases. Cleaning of the filter is accomplished by a motor slowly revolving the filter cartridge, so that each portion of the surface passes momentarily over the backwash nozzel supplied with clean liquid under pressure. Among filter aids, the Dicalite Company, of New York, demonstrated three new aids, Dicalite 20, 40, and 4,200. In addition to the customary fabric and woven-wire media, filter cloth woven of glass was on display. The Filter Media Corporation, Irvington-on-the-Hudson, N. Y., and Owens-Illinois Glass Company, recently announced a cloth that is 100 per cent

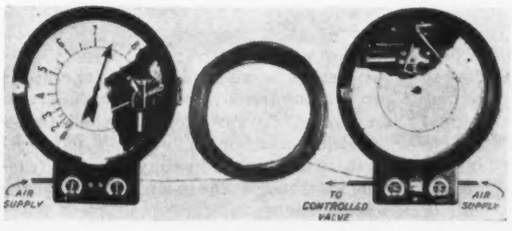
Cuno backwashing filter

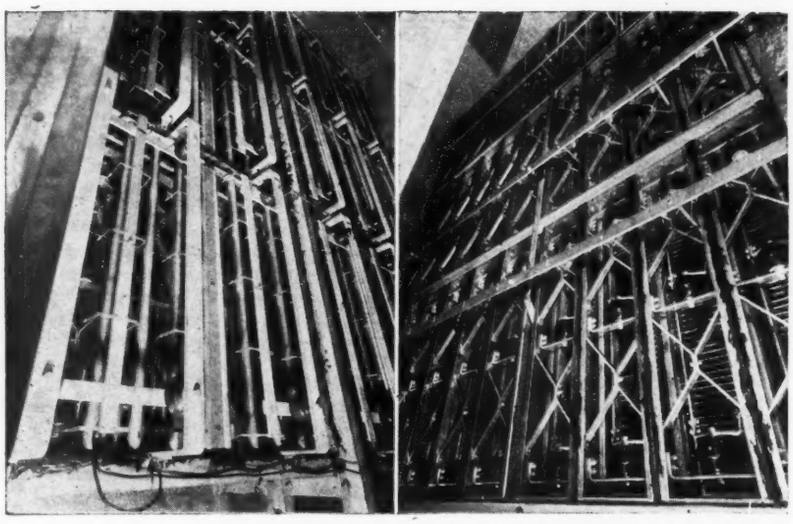


Schneible Junior dust collector



Brown Pneumatic telemeter



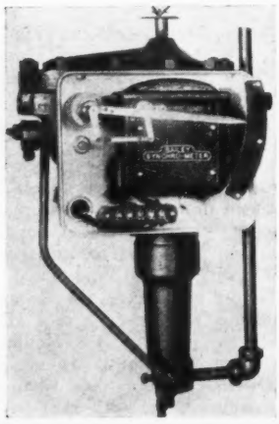


ELECTROSTATIC PRECIPITATOR manufactured by the Westinghouse Electric & Manufacturing Company installed in a large office building in Chicago. Dust-laden air enters on the left and passes through the precipitator viewed on the right. Particles of dust become electrically charged and are deposited on the screen, and the air passes on clean. Experiments involving a similar principle are under way at gold mines in South Africa for collecting dust underground. See page 92.

glass, that is so well woven that it functions as any filter cloth woven from cotton, wool, or metal. It is said to withstand temperatures up to 500 deg. F. (*E.&M.J.* Sept., 1937). A new backing and supporting fabric for dust collector bags and filter cloths known as Interwoven Spiral Matrix Fabric was shown by Korb-Pettir Wire Fabrics & Iron Works, Philadelphia, Pa.

In the field of dust collection the Westinghouse Electric & Manufacturing Company exhibited a unit that employs a small vacuum-tube power pack that is said to be designed for dust-collecting efficiencies as high as 99 per cent by weight to remove particles as small as $\frac{1}{2}$ micron. The smelting field is said to be under investigation by the manufacturer to determine if this equipment may be applicable for collecting valuable mineral dusts now collected in baghouses. The Bowen Research Corporation, Garwood, N. J., exhibited a venturi primary dust collector. Dust-laden air enters a scroll, where it is given a rotational velocity so that the dust is concentrated on the outer surface of the catering cone of the venturi. The dust passes through an annular slot at the throat while the clean air discharges through an expanding tube. Dust-control devices for small installations were demonstrated by the new Junior Multi-Wash dust collector, shown by Claude B. Schneible Company, Chicago, Ill.

In the field of process-control instruments the Bailey Meter Company of Cleveland, displayed its new Synchro-Meter. This is an electrical transmission system for indicating, recording, and integrating such factors as flow rate, pressure, temperature, liquid level, and draft at distant points, that may be recorded on several receivers from one transmitter. The Brown Instrument Company, of Philadelphia, displayed a new pneumatic-control transmission system, that indicates temperature, pressure, flow and liquid level that may be indicated, recorded, and controlled remotely. This unit requires no motor and is said to be applicable where fire or explosion hazard exists. Meters employing the Pyrex glass metering floats for the first time were demonstrated by the Fischer & Porter Company, of Philadelphia. For flue-gas analysis the Leeds & Northrup Company, of Philadelphia, displayed its improved recording instruments. The new CO_2 recorder operates on alternating current, employing a new saturated gas cell.



New Bailey Synchro-Meter

Direct Reversing Diesel Locomotive

A DIESEL LOCOMOTIVE for heavy-duty haulage, that is started, stopped, and reversed in direction by means of a simple hand wheel, was recently supplied in England by Messrs Robert Stephenson & Hawthorns, Ltd., Newcastle, England. In addition to the hand wheel, the

Marion Excavators for 1938

THE MARION Steam Shovel Company, Marion, Ohio, announces its new 1938 line of excavators which are said to combine an abundance of speed for high yardage with precision control over every machine movement. The new line consists of excavators in the $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2 and $2\frac{1}{2}$ cu.yd. class. New and major features are said to include self-cleaning, non-binding crawlers of exceptional length and width, large-diameter supporting axles, "live" roller circles between upper and lower frames for even load distribution, anti-friction bearings at all major points, large diameter rotating clutches, and independent chain crowd. Maximum operating speed is secured with a proper balance of machinery units, conveniently arranged operating levers; clear vision of operator, and by easily actuated large-diameter clutches.

Low maintenance has also been given its due share of consideration in the design of these new excavators according to the manufacturer. Propelling gears are sealed against dirt and operate in oil; chain drive is said to reduce wear on propelling sprockets to a minimum; the least number of wearing parts are used, with no propelling power transmitted through the rear axles to cause wasted energy.

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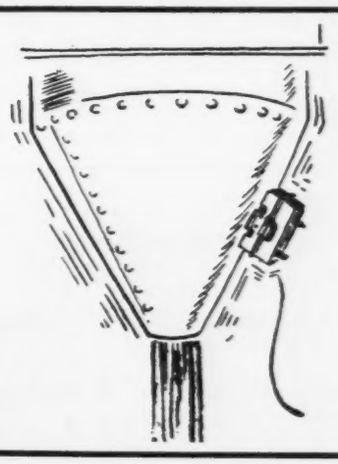

SYNTRON COMPANY

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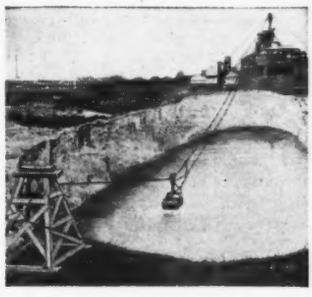


The picture above shows a Sauerman Slackline Cableway digging gravel from deep under water and lifting the gravel to the top of a screening plant. This machine digs, carries, lifts and dumps in a rapid, continuous movement, controlled by one operator.

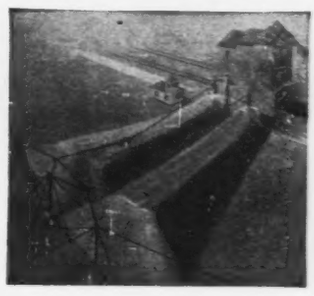
SAUERMAN

LONG RANGE MACHINES

In the Sauerman line of Drag Scrapers, Slackline Scrapers and Cableway Excavators there are machines of both large and small capacity for Open Pit Mining, Placer Mining, Slushing, Stockpiling, etc., etc.

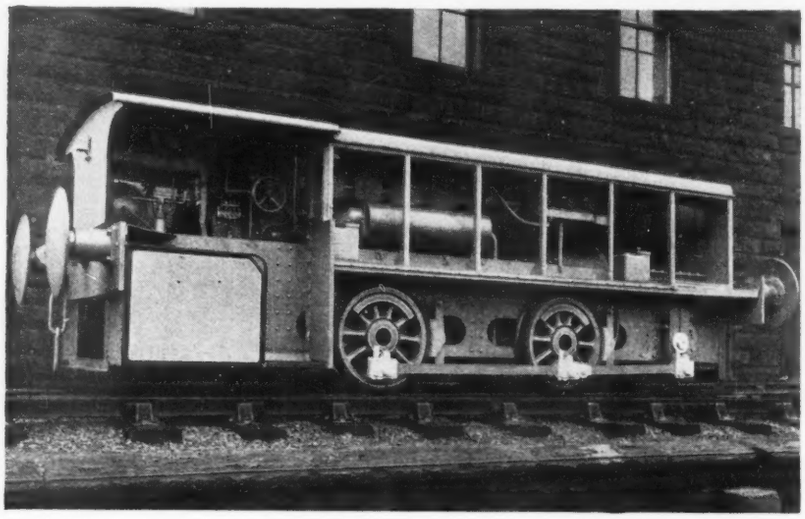
Several hundred varied ways of using Sauerman machines are illustrated and described from actual field data in our new Catalog 18. Write for your copy of this catalog now.

SAUERMAN BROS., 484 S. Clinton St., CHICAGO

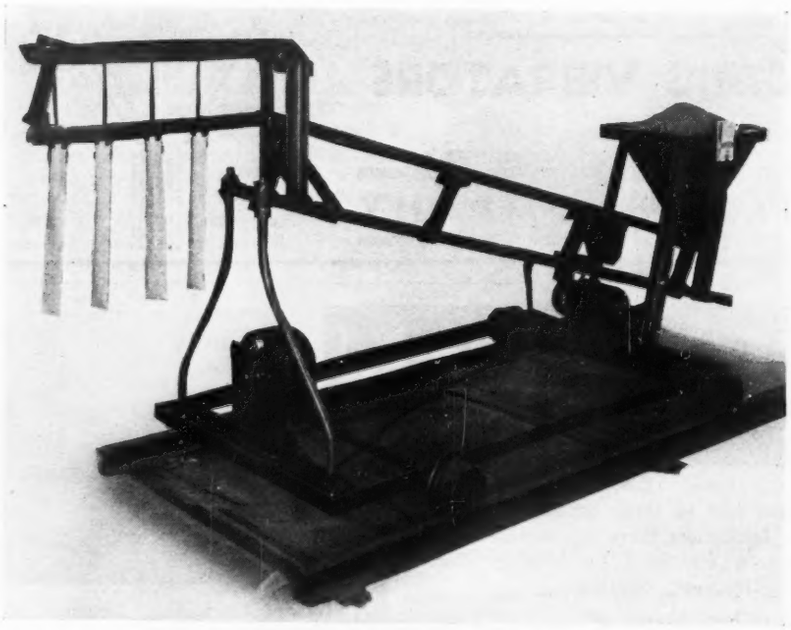


Above is illustrated one method of utilizing a Sauerman Drag Scraper for storing and reclaiming coal, ore, tailings, etc. There are numerous other ways of adapting this equipment to ground storage and indoor storage of various materials.

engine is equipped with a speeder lever, which, through a governor, controls the speed of the engine. These controls are duplicated on each side; therefore, the locomotive can be driven from either side. The engine is a Crossley scavange-pump diesel fitted with detachable liners and it developes 110 b.h.p. in four cylinders at 500 r.p.m. The feature of the locomotive is the quick reversal which it is said to give by compressed air. When compressed air is first admitted to the cylinder the starting torque is greater than the full speed torque of the engine. The manufacturer says that the engine can be reversed from one direction of rotation to the other in less than two seconds. The wheels are 3 ft. 1 in. in diameter and the wheel base is 6 ft. Original starting air for the Crossley power unit described in the foregoing is supplied by an auxiliary petrol-paraffin compressor carried on the front end of the locomotive frame. Starting air after the initial start is supplied by a built-in compressor driven from the engine crankshaft. Air storage bottles are carried in front of the casing and coupled to the manifold and valves by suitable piping. The engine cooling is provided by a centrifugal pump and sectional element Serck radiator with a belt-driven fan.



The drive from the engine is said to be taken through a Vulcan-Sinclair traction-type hydraulic coupling having internal reservoir and transfer tubes. This coupling is bolted to the engine flywheel and is arranged to drive the two-speed epicycle gear box through a cone ring flexible-type coupling. The epicyclic gear box is fitted with an external contracting brake for first gear and a multiplate lubricated friction clutch for the top gear, giving the locomotive speeds of 3 and 6 m.p.h. The gear box has four sets of planet wheels on each train. Westinghouse straight air brake equipment is fitted and arranged to take air through reducing valves from the engine starting bottles. The main fuel tank is carried in the cab and fitted with communications to the engine scavenge air manifold to provide the necessary pressure to the feed pumps. The fuel tank has a capacity of 45 gal.



Rock dust, sand, or clay may be used in the small hopper on the right, which discharges the material on a small vibrating feeder below. Material is conveyed into the dummy bags suspended at the left. This convenient dummy making device for blasting is said to have a capacity of 500 to 600 1⅜x18-in. dummies per hour, and is manufactured by the Tamping Bag Company, Mount Vernon, Ill.

BULLETINS

Bonded Mica. Continental Diamond Fibre Co., Newark, Del., has issued descriptive booklet illustrating manufacture of Micabond, an insulating material for various industrial uses.

Trenchlay and Ruralay Cables. General Cable Corporation, 420 Lexington Ave., New York, N. Y. Booklet describes features of cables used for direct earth installation. Pp. 17.

Mercury Contacts. Jefferson Electric Company, Bellwood, Ill. Catalog 371MT illustrates and describes the manufacturer's line of Ferro-Tube Mercury Contacts. Pp. 3.

Wagon Drill. Ingersoll-Rand Co., 11 Broadway, New York, N. Y. Bulletin 2253-A, describes and illustrates features of the FM wagon drill. Pp. 3.

Welding. Hobart Brothers Co., Troy, Ohio. Catalog called "Arc Welding" tells about welding with the manufacturer's new 40-volt simplified arc welder. Pp. 23.

Core Drill. E. J. Longyear Co., Foshay Tower, Minneapolis, Minn. Bulletin 53 describes the air- or steam-driven Longyear UG upright diamond core drills. Pp. 4. Bulletin 50 describes the junior air diamond core drill. Pp. 7.

Binocular Microscopes. Bausch & Lomb, Rochester, N. Y. Catalog D-15 is devoted to wide-field binocular microscopes applicable for study in mineralogy and metallurgy. Pp. 12.

Insulation. Johns-Manville, 22 East 40th St., New York, N. Y. Catalog 1N-55A contains information on the sheet, block, and pipe insulations which the manufacturer has developed for service on various types of heated and refrigerated equipment in industry. Pp. 32. Industrial Products Catalog contains information and recommendations on high- and low-temperature insulations for industrial purposes. Pp. 64.

Classifier. Nordberg Mfg. Co., Milwaukee, Wis. Bulletin 76 describes the manufacturer's new cone and bowl classifiers. Pp. 11.

Mine Fans. Kelvin & Wilfrid O. White Co., 90 State St., Boston, Mass. American distributors of Therotank, Ltd. (Glasgow, Scotland). Mine and tunnel ventilation fans described in Bulletin M-1. Pp. 11.

Weightometer. Merrick Scale Mfg. Co., Passaic, N. J. Bulletin 375 describes and illustrates the company's weightometers and includes diagrams of conveyor arrangements with weightometers. Pp. 21.

INDUSTRIAL NOTES

Felix Kwast, connected with the engineering department of the Kimball Krogh pump division of Victor Equipment Company for the past year, has been appointed chief engineer, with headquarters at the Los Angeles plant and hydraulic laboratory.

The Falk Corporation announces the appointment of The Transmission Engineering Company, 116 New Montgomery St., San Francisco, as its representative in northern California. This office will be in charge of A. Pedersen.

Morris Machine Works of Baldwinsville, N. Y., announces the appointment of the Lang Company as its representative in Salt Lake City, with offices at 267 West First South St. The Lang company will handle sales of Morris centrifugal pumps and hydraulic dredges in that locality.

Drilling With Detachable Bits—II

The Practice at Certain Western Mines

PART I of this paper, published in the November issue, began the discussion of the practice in regard to use of regular drill steel and detachable bits at eight mines not covered in the three other reports prepared by the same author and previously issued by the United States Bureau of Mines. The present installment continues the description of the practice at "Western Mine No. 1" and begins the discussion of that at "Western Mine No. 2."

Western Mine No. I

(*Continued from page* 104 *of November,* 1937, *issue*)

The shank end of the 1¼-in. rod is heated to 1,800 deg. F. for forging, normalized by reheating to 1,600 deg. F., and cooled in the open atmosphere. In the event that the hole in the steel is undersize, the rod is reheated, punched, and forged to size. The rod is again normalized by heating it to 1,600 deg. F. and cooling it in the open atmosphere. The end is then heated through a length of ¾ in. to 1,450 deg. F. and quenched in water to a depth of ½ in. When the color above the water line has disappeared from view, the steel is withdrawn from the water and polished with emery cloth fastened on a wooden stick. After this buffing, when the dark purple color reaches the end of the steel, it is quenched in oil until cold. The steel rod rests on a screen rack, 2½ in. from the bottom of the quenching tank. Each shank is file-tested before use.

The thread end of the ⅞-in. quarter-octagon steel is heated throughout a distance of 1½ in. from the end of the rod at 1,800 deg. F. for upsetting. Two heats usually are required for this work. Any surface irregularities are removed by grinding. Normalizing is accomplished by heating to 1,600 deg. F. and cooling in the open atmosphere. After the threads are cut, the rod is again normalized. An overlapping quenching heat is given at 1,540 deg. F.

The shanks on the ⅞-in. quarter-octagon steel are plain and are not forged. After normalizing at 1,600 deg. F., they are hardened in the same manner as the shanks on the 1¼-in. rods. For the ⅞-in. hexagon steel, a similar treatment is given, except that a collar is forged on the shank.

Each miner is furnished one set of rods. These rods may be exchanged at an underground tool house whenever replacement becomes necessary.

An experienced miner facilitates the removal of the bit from the rod by keeping the compressed air on the machine for a moment after he starts extracting the steel from the hole and by unscrewing the bit immediately after removing the drill steel from the machine.

The loss of detachable bits is approximately 1.5 per cent of the number issued. No especial trouble has been experienced with the rock crushers at the head of the mill because there is an occasional bit in the feed.

Based on a record of the circulation of drill steel over a five-month period, the service ratio of regular drill steel to drill rods for detachable bits is 1 to 57. This means that in a given time the number of uses for a rod carrying detachable bits is 57 times greater than that for a piece of regular drill steel. Thus, it is to be noted that more than a year's normal service for a piece of regular steel is crowded into one week for a rod with detachable bits. The actual number of rods in service, including spares and other reserves, is 11.5 per cent of the number of pieces of regular drill steel formerly in service for the same number of operating machine drills. The transportation ratio or the weight of detachable bits and rods compared to the weight of regular drill steel required for the same number of operating machine drills is 1 to 24. Or translated into percentage, the use of detachable bits has effected a reduction of 95.85 per cent in the total weight of steel transported.

Table I—Shop Costs for Detachable Bits, Western Mine No. 1

	Number of Units	Cost per Unit	Cost per Bit Dulled	Cost per Foot Drilled
Bits				
Total Regrinding	5,362	.....	$0.0362	.....
Total.....	5,362	$0.0350	0.0280	.....
Labor.....	5,362	0.0325		
New wheels...	5,362	0.0025		
Hardening				
Total.....	5,362	0.0103	0.0082	.....
Labor.....	5,362	0.0099		
Supplies.....	5,362	0.0004		
Rods				
Total forging shanks and thread end.	216		0.0177	
Total.....	216	0.2563	0.0103	.....
Labor.....	216	0.2563		
Supplies.....	216	.....		
Threading.....	216	0.1634	0.0066	.....
Repairing unplugging and straightening	25	0.2132	0.0008	.....
Total.....	.....	.....	0.0539	$0.0060

Table II—Comparison of Penetration, Western Mine No. 1

	Regular Steel	Detachable Bits
Number of machine-shifts....	46	16
Feet drilled.....	2,589	1,856
Bits dulled.....	1,288	208
Feet per bit dulled.....	2.01	8.92
Feet drilled per machine shift.	56.28	116.00

Table III — Average Transportation and Shop Costs, Western Mine No. 1

	Cost per Bit Dulled	Cost per Foot Drilled
Transportation (exclusive of miner's time).....	$0.0420	$0.0209
Shop cost, sharpening (exclusive of new steel or steel replacements).....	0.0516	0.0257
Total transportation and shop...	0.0936	0.0466

Comparative Performance and Costs—Average cost per machine-shift for operating all drills using detachable bits is $3.57. The drills are principally jackhammers, with some stopers and drifters. Cost includes compressed air, which averages 25,000 cu.ft. per machine-shift, pipe lines, machine repairs, drill steel, bits, and transportation of rods and bits, but excludes labor in drilling. Drill-shifts used in compiling the above cost total 245,000. Using 116 ft. drilled per machine-shift, the total cost exclusive of labor in drilling is $0.031 per foot drilled. The purchase price for new detachable bits amounts to $0.0475 per bit dulled, or $0.0053 per foot drilled.

Detailed shop costs for detachable bits, taken from a representative month in 1936, are given in Table I.

Records for April, 1935, showed that the penetration of the detachable bit for each use was 4.44 times that of the cyanide-treated conventional bit on regular drill steel. Details of this test are given in Table II.

A five-months' average for transportation and shop costs for conventional bits on regular drill steel was $0.0466 per foot drilled. Details are given in Table III.

Although costs for drilling with conventional and with detachable bits have not been segregated in such a manner as to permit the comparison of all the details, there is a marked reduction in the total cost per foot of drilling through the use of detachable bits.

United Verde Extension Mining Company, Jerome, Ariz.

Summary—Through a wide range of drilling conditions, the detachable bit has increased the number of feet drilled per bit as well as the drilling speed and has reduced the cost of nipping. The diminished scale of op-

erations and the large stock of regular drill steel have retarded the adoption of detachable bits throughout the entire mine. Complete costs to compare detachable bits with conventional bits are not available at present.

Rocks Drilled—The rocks drilled are silicified gossan, diorite, greenstone, schist, and porphyry. A variety of drilling conditions is encountered, from occasional sticky ground through irregular seamy areas to hard and abrasive rock.

Operating Practice — The cylinder diameters of the machine drills in service are as follows: Drifters, 3¼ in.; jackhammers, 2¼ in., hand-rotated stopers, 2¾ in.; and automatic rotated stopers, 2⅛ in. Anvil blocks are used in stopers only. There is one operator per machine. The air pressure is 100 lb. per square inch at the compressor and from 80 to 90 lb. at the drill.

Three sections of drill steel are in use—viz., 1⅛-in. hollow ground with lugged shanks for drifters, ⅞-in. hollow quarter-octagon with plain shanks for stopers, and ⅞-in. hollow hexagon with collared shanks for jackhammers. The bits are the four-point type with an angle of 90 deg. between cutting faces and with double clearance tapers of 5 deg. and 14 deg. The gage change is ⅛-in. on a drill run of 18 to 24 in. Most bits have a central hole, but a few bits for use in sticky ground have a side hole.

Bits are forged at an estimated 1,800 deg. F. and are reheated to 1,500 deg. F. for hardening. They are quenched in water.

The shanks are subjected to a forging heat of 1,800 deg. F. and are cooled in the open air. The ends are then reheated to 1,600 deg. F. through a distance of 2 in. and after treating with a hardening compound are quenched in oil.

Conventional Bits—With conventional bits on regular steel approximately 1.5 ft. are drilled per bit dulled. The feet drilled per machine-shift in drifts and crosscuts varies from 60 to 70, depending upon the ground, whereas in stopes it is about 50. Drill holes average 5.5 ft. in depth.

The sharpening shop is on the surface near the collar of the supply shaft. Its equipment comprises the following: 2 oil-burning furnaces for forging heat, 1 oil-burning furnace for hardening heat, 2 machine sharpeners, 2 punches, 2 portable steel rack supports, 2 sliding steel racks at furnaces, 1 double emery wheel, 1 air hammer, 2 anvils, 1 forge, 2 quenching tanks, and various small tools. High-pressure air from the mine compressed-air mains is used in the furnaces. The steel drills are loaded on special cars, which run on rails through one portion of the shop and on steel turnsheets through the remainder. Dull steel from the mine is placed in bins along the walls of the shop. Sharp steel is loaded directly from the quenching trough into the special steel cars. These are constructed with compartments formed by metal dividers so that the drill steel stands vertically in the car. Underground, the nippers push the steel cars from the shaft stations to distributing points, whence the miners carry the steel to the working faces. The nippers collect the dull steel at the face.

With an output of 300 pieces of drill steel per day, two men are required in the shop for unloading, sorting, cleaning, sharpening, hardening, and loading. The total shop cost per bit sharpened, including steel loss, is estimated to be $0.10.

Detachable Bits—Detachable bits are used principally in development through schist and in stopes where the nipping cost is high. Short time studies have indicated a greater number of feet drilled per bit and a higher drilling speed than with regular drill steel. As yet, no actual operating data are available for complete detailed comparisons. On the present diminished scale of operations, there is a comparatively large quantity of regular drill steel on hand, which has tended to retard the adoption of detachable bits throughout the entire mine.

A Homemade Grinder

Detachable bits are reground on a homemade machine by the rock-drill repairman in his shop adjoining the collar of the shaft. The bit grinder consists of a double emery wheel with a 12-in. forming wheel and a 10-in. gaging wheel. A guide for the bit holder was developed by cutting a 2-in. pipe in half, longitudinally, through a length of 5 in., and by welding one of these pieces to a post supported by the tool rest supplied with the original equipment. The trough thus formed was sloped at an angle of 14 deg. from the horizontal and was notched at its lower end to conform to the bevel of the wheel. Two lugs, ¼ x ½ x 1 in., were welded near the upper end of the pipe to maintain the bit holder in alignment. The bit holder itself was simply a short shank of jackhammer steel, onto which the bit was screwed.

Drill steel for use with detachable bits is ⅞-in. hexagon and ⅞-in. quarter-octagon. The bits are four-point with side hole. There are four regrinds or five uses per bit. About ten bits are dulled per day. Bits are resharpened at the rate of fifteen per hour. One sharpening wheel will grind 1,000 bits. Detachable bits are not reforged nor rehardened at this property. New bits purchased average 50 per month.

In reconditioning rods, the thread is heated to an estimated 1,800 deg. F. and upset in a machine sharpener. Threads and shoulder are cut in a bolt machine with a special set of dies. After heating to approximately 1,450 deg. F. and sprinkling with a hardening compound, the thread end is quenched in oil until cold. The shank end is given heats for forging and hardening that correspond to those mentioned in the foregoing. Total rod breakage is less than 1 per cent.

Bits are exchanged by the miners on the surface at the sharpening shop. The bit carrier is a simple wire loop. There have been no broken bits, and the percentage of bits lost is negligible.

Western Mine No. 2

Summary—Detachable bits are used exclusively in driving drifts, and conventional bits are used in stoping, raising, and shaft sinking. The large number of hand-rotated stopers in service has prevented the use of detachable bits in stoping and raising.

To overcome this limitation, an experiment is being conducted for adapting detachable bits to hand-rotated stopers by means of a ratchet in the fronthead, but the results are not yet conclusive.

Because of the distinct separation of the two systems of drilling, operating data are not available for detailed comparisons. Notwithstanding the fact that the shop cost of forging conventional bits on regular drill steel is less than the purchase price of detachable bits plus the cost of regrinding, the advantage in the cost per foot drilled appears to be with the detachable bits because of the large savings in transportation expense and the reduction in the loss of steel.

Rocks Drilled—Rocks drilled are principally diabase, sulphide ore, and some sediments. Because these vary from hard to soft, there is a variety of drilling conditions, although there is no sticky drilling. The siliceous, massive sulphides are especially abrasive.

Operating Practice—The diameters of the cylinders of the machine drills now in use are as follows: Drifters, 3 and 3½ in.; hand-rotated stopers, 2¾ in.; jackhammers, 2½ and 2⅝ in. Drifters have a 30-in. run; stopers, 13 in.; and jackhammers, 24 to 28 in. One man is used per machine, except for drifters in large headings, where a miner and a helper are required. Air pressure at the drill is about 80 lb. per square inch.

Excerpted from United States Bureau of Mines Information Circular No. 6951, written by McHenry Mosier. Previous published circulars on the same subject by the same author are I.C. 6877, 6911, and 6936.

(*To be continued*)